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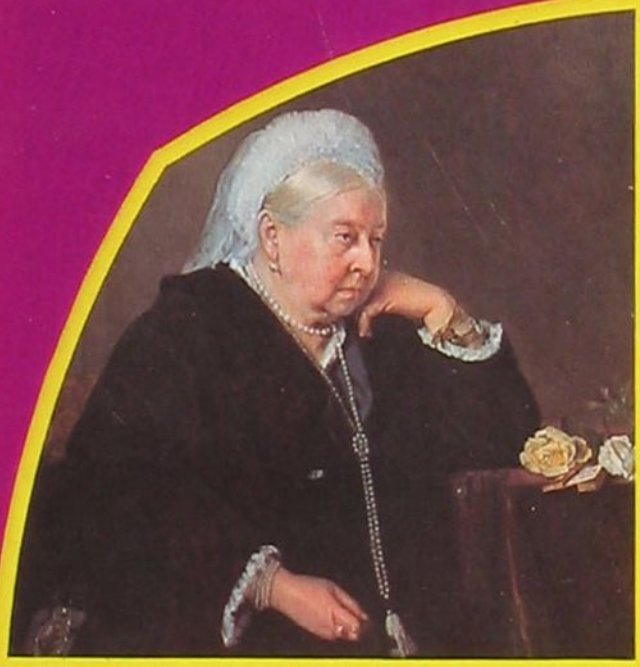

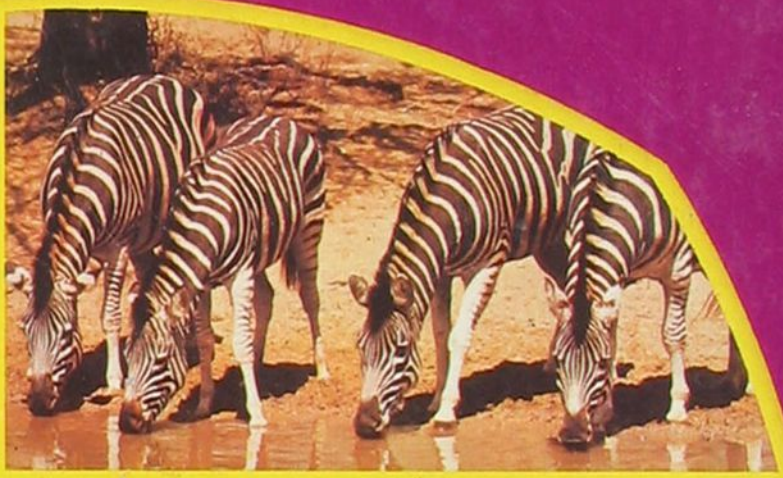

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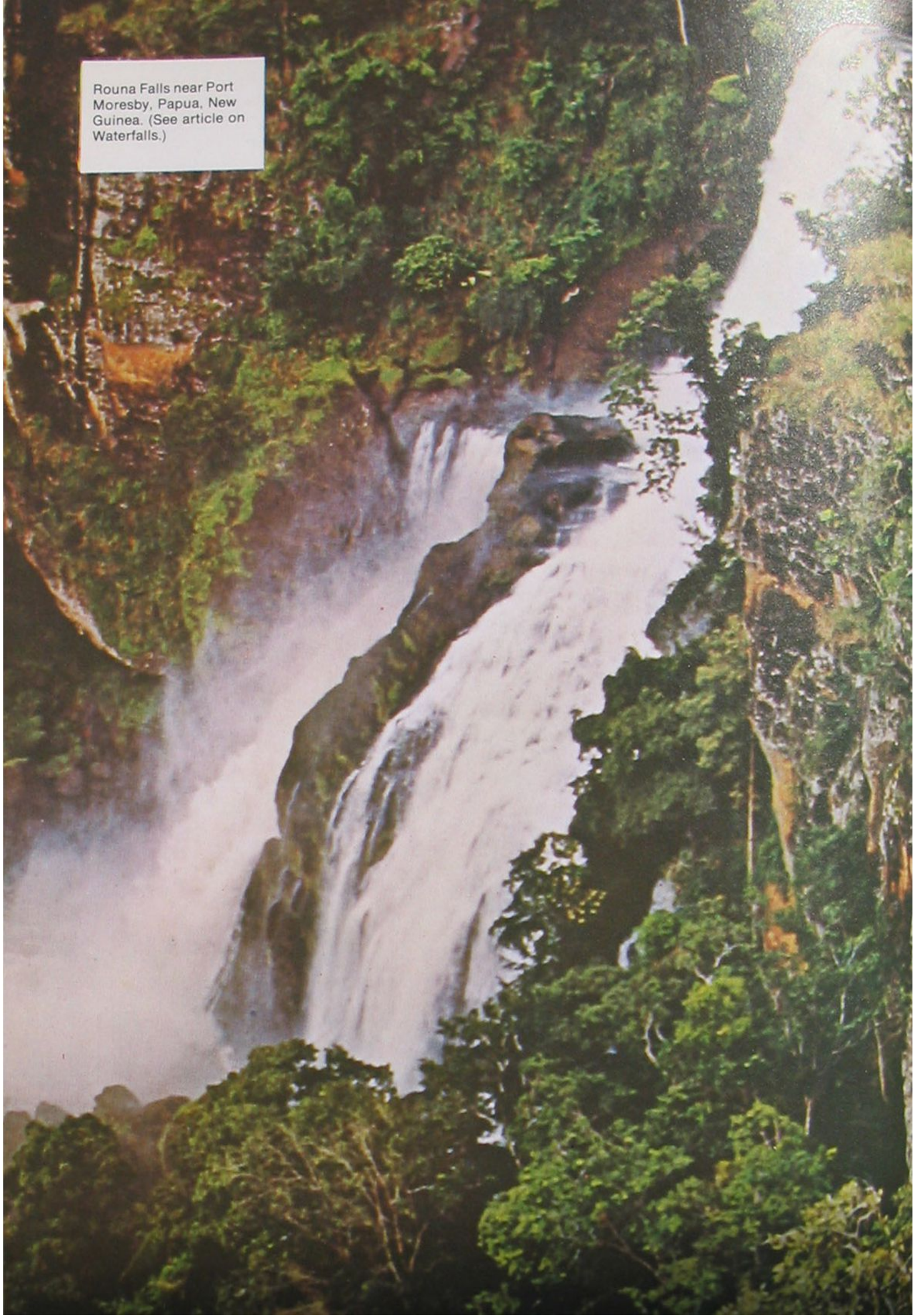


Rouna Falls near Port Moresby, Papua, New Guinea. (See article on Waterfalls.)

Left: The map shows the location of Venezuela in South America.

Facts and Figures
Area: 352,143 square miles.
Population: 10,778,000.
Capital: Caracas.

Venezuela, on the northern coast of South America, is one of the world's leading oil producing countries.

The country is bordered by Colombia on the west, the Caribbean Sea on the north, Guyana on the east, and Brazil on the south. Highlands in the south of Venezuela consist of a forested plateau, where American Indians still follow tribal ways of life. The Orinoco River flows through a wide plain to the north of the highlands.

Mountains lie near the coast, to the north and west of the Orinoco plain. On the coast, the climate is very hot and humid, but the mountains have a warm and pleasant climate. Lake Maracaibo, in the west, is surrounded by mountains.

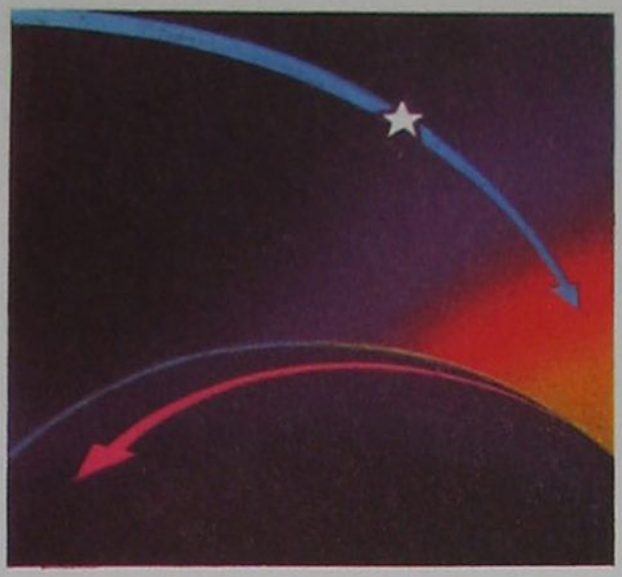
Venezuela is rich in minerals. Petroleum forms more than nine-tenths of its exports. It also has diamonds, copper, coal, iron ore and natural gas. The forests contain much valuable timber. Cocoa-beans, coffee and cotton are among the most important crops.

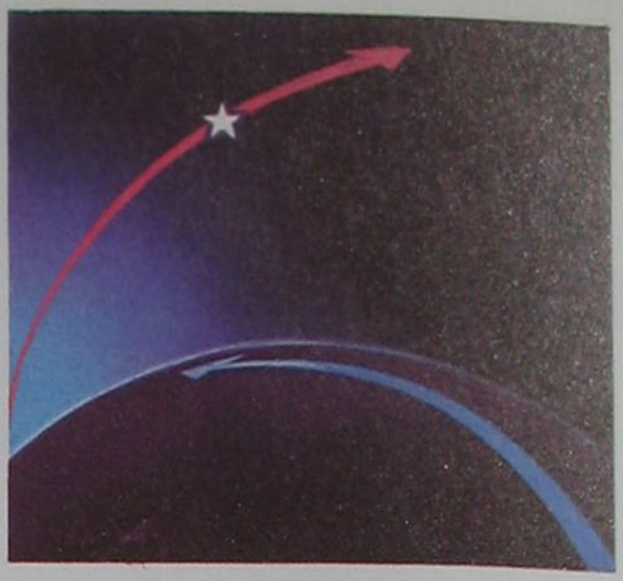
Most Venezuelans are *mestizos*—people of mixed European and Amerind ancestry.

The Spaniards colonized Venezuela in the 1500's and it became independent in 1811. After many changes of government it now has an elected president and congress. In 1968, the Guri Dam was completed, forming one of the world's biggest hydro-electric schemes.

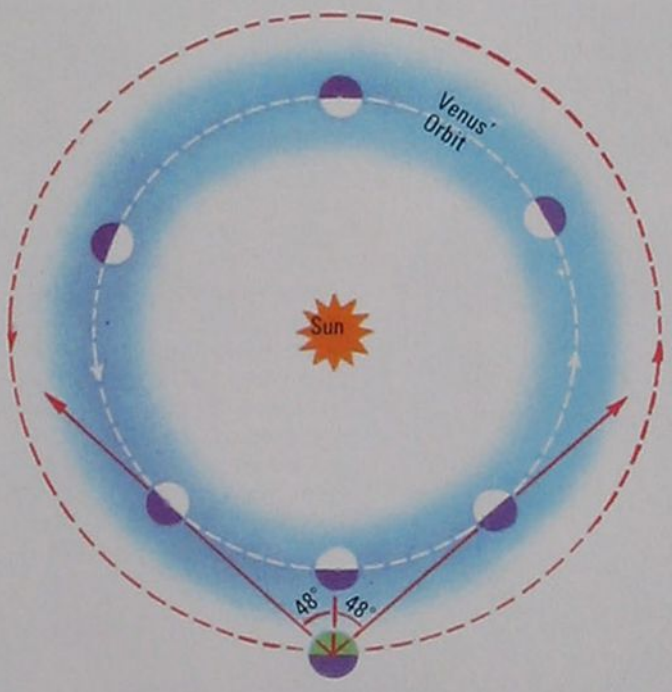
Venice (pop. 368,000) is a city and seaport of Italy. It is situated in the crescent-shaped Venetian Lagoon, in a bay at the head of the Adriatic Sea. A railway viaduct connects it with the mainland.

Venice is famous for its beautiful waterfront, over which soars the *campanile* (bell-tower) of St Mark's. The city is crisscrossed by a network of canals, and for centuries the usual means of transport has been the gondola, a black-painted boat rowed by a gondolier.





Above left: Venus is always fairly close to the Sun. Sometimes it appears as an evening star, crossing the sky as the Sun sets.
Above right: At other times it is a morning star, rising before the Sun. Like the stars, Venus appears to move in the opposite direction to the spin of the Earth.
Below: Venus never appears more than 48° East or West of the Sun. Like the Moon, it has *phases* because it lies between the Earth and the Sun.



Below: Venus (left) compared in size with the Earth. It is very slightly smaller.

Innumerable shallow canals, negotiated by long narrow boats called *gondolas*, separate the many islands on which the city is built.

In the Middle Ages the Venetians built a powerful trading state. It is a city of marble palaces and churches and buildings of great architectural merit. For centuries it has been a centre of art, and is rich in art treasures. It has important manufactures in glassware and gold and silver work.

Many tourists visit Venice to enjoy its beauty. Unfortunately, industrial effluent from the mainland has heavily polluted the canals in recent years. Deep water channels have been made around Venice and these have caused so much subsidence, that the city is in danger of sinking.

Venus is the second planet of the Solar System. Its *orbit* (path round the Sun) lies outside that of Mercury but inside the Earth's. It is about the same size as the Earth—7,700 miles across. It is often visible as a brilliant white star, sometimes low in the west after sunset and at other times in the east before dawn.

Like the Moon, Venus shows *phases*. We can see only the part of Venus that faces the Sun. This part appears crescent-shaped, 'new', or 'full', depending upon the positions of Venus, the Earth, and the Sun relative to each other.

Although Venus approaches the Earth

more closely than any other planet, astronomers have been unable to discover much about it because its surface is hidden by a dense layer of cloud.

In 1962 the American space-probe Mariner II passed within 20,000 miles of Venus. Information it sent back to Earth indicated that the surface of Venus had a temperature of 400° C, far hotter than had previously been believed. This means that oceans cannot exist there, as any water would be turned into steam immediately. Later space probes have discovered that the atmosphere of the planet is mainly made up of carbon dioxide.

It has been established that Venus turns very slowly upon its axis. A day on Venus may be three or four Earth-months long. The planet takes 225 Earth days to make one orbit around the Sun.

This map shows the location of Vermont.

Vermont is a small state of the United States on the Canadian border. It is the only New England state without a seacoast. Its picturesque countryside and ski resorts in the Green Mountains attract visitors throughout the year. About two-thirds of the state's 444,000 people live in rural areas. The state capital is Montpelier.

Vermont has many small factories that produce stoneware, machinery and machine tools. Dairying is the main agricultural activity.

French explorers originally visited Vermont and claimed the area for France. It passed to Britain in 1763, after the French and Indian War. During the Revolutionary War, the Green Mountain Boys of Vermont defeated British troops at Fort Ticonderoga. Vermont was an independent republic from 1777 until 1790, when it joined the Union.

Versailles is a town outside Paris, in France, famous for the luxurious palace built there by King Louis XIV, in the latter half of the 17th century. Surrounded by magnificent gardens it is one of the

The name Vermont means 'green mountain', and through the middle of this little New England state run the Green Mountains. The dairy cattle that graze on the slopes are important to Vermont's economy, but much of its income comes from tourists. There are many ski resorts and other recreation areas.

Louis XIV, the 'Sun King', established his court at Versailles and collected all the important nobles together in the Palace. His motive in doing this was to get them away from their estates to prevent the constant quarrelling which had occurred in the reigns of his predecessors. The court life was very dull and full of forms and ceremonies.

largest and most opulent buildings in the world, intended to show the splendour of the most powerful monarch of that time. Although it lacks the unity of a great architectural work, it is undoubtedly a great achievement. Its great Hall of Mirrors is one of the most remarkable chambers in the world.

Vertebrates, forming an important part of the animal kingdom, are animals with backbones. They consist of lampreys, cartilage fishes, bony fishes, lungfishes, amphibians, reptiles, birds and mammals.

Vespucci, Amerigo (1451-1512), was the man after whom the continents of North and South America were named. Vespucci was an Italian merchant and a navigator. He was born in Florence. He claimed to have crossed the Atlantic and discovered the 'New World' in 1497. He published letters about his voyage that many people believed. But, in fact, Christopher Columbus had sighted the continents five years earlier. For this reason, Columbus is credited as the discoverer. Though Vespucci may have crossed the Atlantic in 1497, he served only as ship's pilot. Vespucci also claimed to have made three later voyages.

Vesuvius is a volcano on the western coast of Italy, overlooking the Bay of Naples. It is the only active volcano on the European mainland, and one of the most famous in the world. Vesuvius has erupted many times in history. Its most famous eruption was in A.D. 79, when lava and ash buried the cities of Herculaneum and Pompeii in a matter of hours. The most recent destructive eruption occurred in 1944. The cone-shaped volcano has a deep crater, 2,000 feet across. The height of the peak changes after each major eruption. Some well-known wines are produced from grapes grown on the slopes of Vesuvius.

Veterinary medicine is the care and treatment of sick animals. Veterinary surgeons —animal doctors—are usually called *vets* for short. They are specially trained to deal with injured animals, and to identify the diseases that animals suffer from. A vet does nearly all the things an ordinary

A vet and his assistant operate on a cat. The veterinary surgeon is trained to look after all kinds of animals; in towns they usually deal most with domestic pets but in the country they also care for farm animals.

Queen Victoria, whose 63-year reign dominated the 19th century giving it the 'Victorian Age'.

doctor or dentist does. He gives drugs, performs surgery and extracts teeth. He also uses X-rays, and tests blood samples. But the vet's job is often more difficult than that of an ordinary doctor's, because the patient cannot tell him 'where it hurts'. Sometimes vets must deal with dangerous animals, such as tigers or poisonous snakes.

Vets spend much of their time helping farmers. They inspect herds of cattle for diseases, such as tuberculosis, which can be transmitted to Man through milk. They give injections to prevent pig cholera and other serious infections. They are also called in to treat sick horses and sheep. Part of their job is seeing that the other animals do not catch the infection.

In towns, vets spend most of their time treating household pets. They give dogs distemper injections, and they look after sick cats and birds. Vets also treat zoo and circus animals. Government ministries employ vets to inspect meat.

Victoria (1819-1901) reigned as queen of Great Britain and Ireland for 63 years. Hers was the longest reign in British history. While she was on the throne, the British Empire reached its greatest power. In 1876, she was declared Empress of India. Other important events included the creation of the Dominion of Canada in 1867 and the Commonwealth of Australia in 1901.

Victoria was the daughter of the fourth son of King George III. Her mother's father was Duke of Saxe-Coburg, in Germany. She became queen at the age of 18, and at first relied heavily on the opinion of her prime minister, Lord Melbourne. From him, she gained a knowledge of politics. In 1840 she married her cousin, Prince Albert of Saxe-Coburg-Gotha. They had nine children. Albert was a patron of the arts and sciences and Victoria was greatly influenced by his judgement on all matters. When he died, in 1861, she went into deep mourning. For many years, she hardly ever appeared in public. But her golden jubilee (marking 50 years on the throne) and her diamond jubilee (60 years) were occasions for great celebration. Victoria restored the prestige of the Crown after the disrepute into which it had fallen.

Victoria Falls occur on the River Zambezi, about midway between its source and its mouth, between Zambia and

A view of Victoria Falls. Livingstone discovered it after being told about 'The Smoke that Thunders' by the natives. He named it after Queen Victoria.

Rhodesia. It is the largest waterfall in Africa. The river is about a mile wide at that point, and plunges into a deep narrow chasm. It falls 335 feet in the middle, and shelves off to 256 feet on the Rhodesian side. In the rainy season the volume of water reaches a peak of about 75 million gallons a minute, but this tails off to 3¾ million gallons a minute in the dry season. Some of this enormous water power is converted to electricity by a hydro-electric system on the river's banks.

The mist caused by the spray, and the roar of falling waters can be seen and heard for several miles. Livingstone discovered the falls in 1855.

Victoria Nyanza or **Lake Victoria,** in east-central Africa, is the second largest fresh-water lake in the world (after Lake Superior). Its total area is 26,828 square miles. The lake is situated where the borders of Uganda, Kenya and Tanzania meet, on a high plateau about 3,700 feet above sea level. Its maximum depth is 270 feet. From Victoria Nyanza, water spills over Ripon Falls to the River Nile. Of several rivers feeding the lake, the Kagera is the longest. A dam for hydro-electric purposes has been built at Owen Falls. The first European to see the lake was John Speke in 1858. Henry Stanley explored it more thoroughly in 1875.

Victoria is Australia's most densely populated state. It has 3,480,800 people, and covers 87,884 square miles. Only Tasmania is smaller in area. Victoria is in the extreme south-east of the country. The Indian Ocean, Bass Strait, and the Tasman Sea bound it on the south. To the west lies South Australia, and to the north, across the Murray River, is New South Wales.

The Australian Alps, which run east-west across the state and also cover the north-eastern corner, are a prominent feature. Several peaks are more than 6,000 feet high. The fertile plains of the Murray River and its tributaries lie to the north of the mountains. The Mediterranean climate of the Murray Basin encourages fruit-growing. To the south of the mountains, the central district is dominated by Melbourne, the state capital and largest city. Melbourne is a port, situated at the head of Port Phillip Bay (a large inlet of the sea). To the east of Melbourne, in the fertile pastures of Gippsland, there are many dairy farms. The Wimmera district, in the west-central part of the state, is a mixed wheat-growing and sheep-rearing area. The Mallee plains, an area of scrubland and the driest part of the state, are in the north-west.

This map shows the location of Victoria.

Industry provides most of Victoria's wealth. Melbourne, nearby Geelong, and Ballarat and Bendigo (two former gold-rush towns) are important manufacturing centres. The state produces a wide range of goods, from heavy items such as motor-cars, aircraft and farm tractors to clothing, furniture and canned fruit. Today, coal is the most important mineral. Much of it is used to generate electricity. Other sources of power are hydro-electric schemes on the Murray River and the Snowy Mountain Scheme.

Cereals, especially wheat and oats, are among the leading agricultural products of Victoria. Sheep are reared for their wool and meat, and dairy farming is important. A wide variety of fruits is grown, including citrus fruits; peaches, pears and apricots for canning; and grapes for drying as raisins.

Early visitors to Victoria, such as George Bass, John Murray and Matthew Flinders, explored the coast and bays in the late

This curiously eroded rock formation, on the coast of the Australian state of Victoria, is known as London Bridge. It is near Port Campbell.

1700's and early 1800's. Later, land expeditions, led by Sir Thomas Mitchell, and Hamilton Hume and William Hovell, pushed south from New South Wales.

The first settlements, at Portland in 1834 and Melbourne in 1835, were made by Tasmanians who brought sheep with them and established ranches. Victoria was part of New South Wales until 1851, when it became a separate colony. In that year, gold was discovered at Ballarat, and before long Victoria was producing about a third of the world's supply of that metal. The prospect of easy riches drew thousands of settlers to Victoria not only from other parts of Australia but also from many distant countries. When Australia received Commonwealth status in 1901, Melbourne was the leading city in the country.

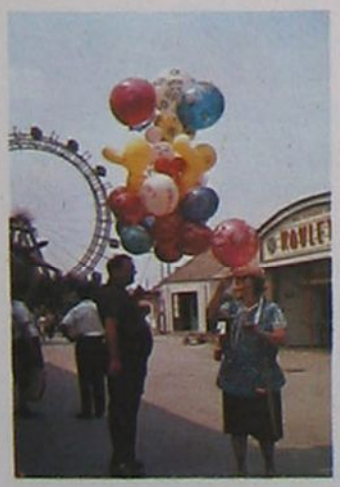
Victoria is the capital of British Columbia, Canada's south-westernmost province. The city lies at the south-eastern tip of Vancouver Island. With its suburbs, it has a population of 173,500. Victoria is a busy port handling coastal and Pacific Ocean shipping. Deep-sea fishing fleets bring their catches to the city's canneries. There are also shipbuilding yards and a base of the Royal Canadian Navy. Sawmills and paper mills process the lumber which is felled in the nearby forest-covered mountains.

The Hudson's Bay Company founded Victoria in 1843 as a fur-trading post. The discovery of gold in British Columbia in 1858 spurred the city's growth as a supply centre for prospectors. In 1868 it became the capital of British Columbia colony. The coming of the Canadian Pacific Railway to the coast in 1886 increased Victoria's prosperity.

Vienna (pop. 1,643,000) is the capital of Austria. The city also ranks as a province of the Federal Republic. It is situated on the River Danube and is an important commercial centre with large grain and cattle markets, and iron and steel works. The city centre encircled by the tree-lined Ringstrasse boulevard, is dominated by the old baroque palaces of the 17th century and now used as govern-

The Hofburg, Vienna, was formerly the Winter Palace of the Emperors. It is now used by the President of Austria for state functions.

ment offices, museums and libraries. The Hofburg, a former imperial residence, is used for presidential ceremonies. Vienna is predominant in the music world, its opera and orchestras foremost in their field.



A balloon-seller in the Prater Leben, Vienna. The Big Wheel in the background figures in a scene in 'The Third Man', a celebrated film set in the city.

Vietnam is a tropical region in south-eastern Asia. It is divided into North Vietnam and South Vietnam. Each country has its own capital and government.

High forested mountains line Vietnam's border with China and Laos. The Red River brings floods to the north during heavy rains. The most fertile land is in the delta of the great Mekong River in the extreme south.

Most Vietnamese are plain-dwellers, who grow rice and other crops. Fishing is important. Foresters produce timber and products such as rubber and quinine. Coal and other minerals are mined.

The Vietnamese began to move southwards from China more than 2,000 years ago. By A.D. 1000, they occupied all Vietnam. Between about 1858 and 1880, France took all Vietnam. Later, they united it with Laos and Cambodia to form *Indo-China*.

Japan occupied Indo-China during World War II. After the war, Ho Chi

Minh, a nationalist-communist leader, established a republic. France agreed to the republic, but later withdrew its consent. Led by Ho Chi Minh, forces in the north fought the French and defeated them by 1954. An international agreement made North and South Vietnam independent republics.

Rebels called the *Viet Cong* fought the South Vietnamese government and were aided by North Vietnam. During the early 1960's, the United States assisted South Vietnam. Several revolts toppled weak governments in South Vietnam.

By the late 1960's, full-scale war spread to all Vietnam. American aircraft bombed North Vietnam and half a million American soldiers fought alongside South Vietnamese troops. Peace talks began in Paris in 1968. Many Americans were against the Vietnamese war and in 1969, President Nixon began to reduce the number of American troops there. In early 1973, a peace agreement was finally signed and an uneasy truce began.

A South Vietnamese company commander, accompanied by an American adviser, leads an assault on a rice warehouse occupied by the Communist Viet Cong.

Facts and Figures

Area: 61,294 square miles (North Vietnam); 65,948 square miles (South Vietnam).

Population: 21,200,000 (North Vietnam); 18,000,000 (South Vietnam).

Capital: Hanoi (North Vietnam); Saigon (South Vietnam).

Above: This map shows the location of Vietnam. Right: A Vietnamese girl paddles her way along a river through peaceful countryside. Much of the countryside was devastated in the bitter fighting between North and South.

The Viking ships were very fast and efficient, despite their small size. They were clinker built (with overlapping planks) and made use of both sails and oars.

Vikings came from the areas of modern Denmark, Norway and Sweden. Their countries were poor and over-populated, so they took to the sea to make a living as pirates and traders. Their ships were the best in Europe, clinker built, with good sails and keels. The Vikings covered incredible distances. In 890 Othere of Halgoland sailed round the North Cape, the very north of Norway, into the White Sea. Later he visited Alfred the Great and told the English king of his voyage. The Atlantic coasts of Britain and Europe and even North Africa were raided by Vikings. They reached Iceland in 867 and began to settle there, bringing their parliament—the 'Althing'—with them. They crossed the ocean to Greenland, which Eric the Red reached in 992, and settlers followed him. From Greenland Vikings explored the coast of Vinland, North America, where their camps are being discovered by archaeologists.

Swedish Vikings moved into Russia up the rivers. They settled around the towns they built, at Novgorod and Kiev. They were known as Rus and have given their name to the land they conquered. Between 806 and 914 they attacked Constantinople. The Byzantine Emperor recruited a 'Varangian Guard' from among these Vikings. We know that some of them reached Athens because a marble lion found in the harbour has an inscription in runes, Swedish lettering.

Vikings settled in many parts of Britain and in northern France. In 886 Alfred had to accept Viking rule in the 'Danelaw', eastern England. In 911 Charles the Simple, King of France, granted land to the 'Northmen'; this became the Duchy of Normandy.

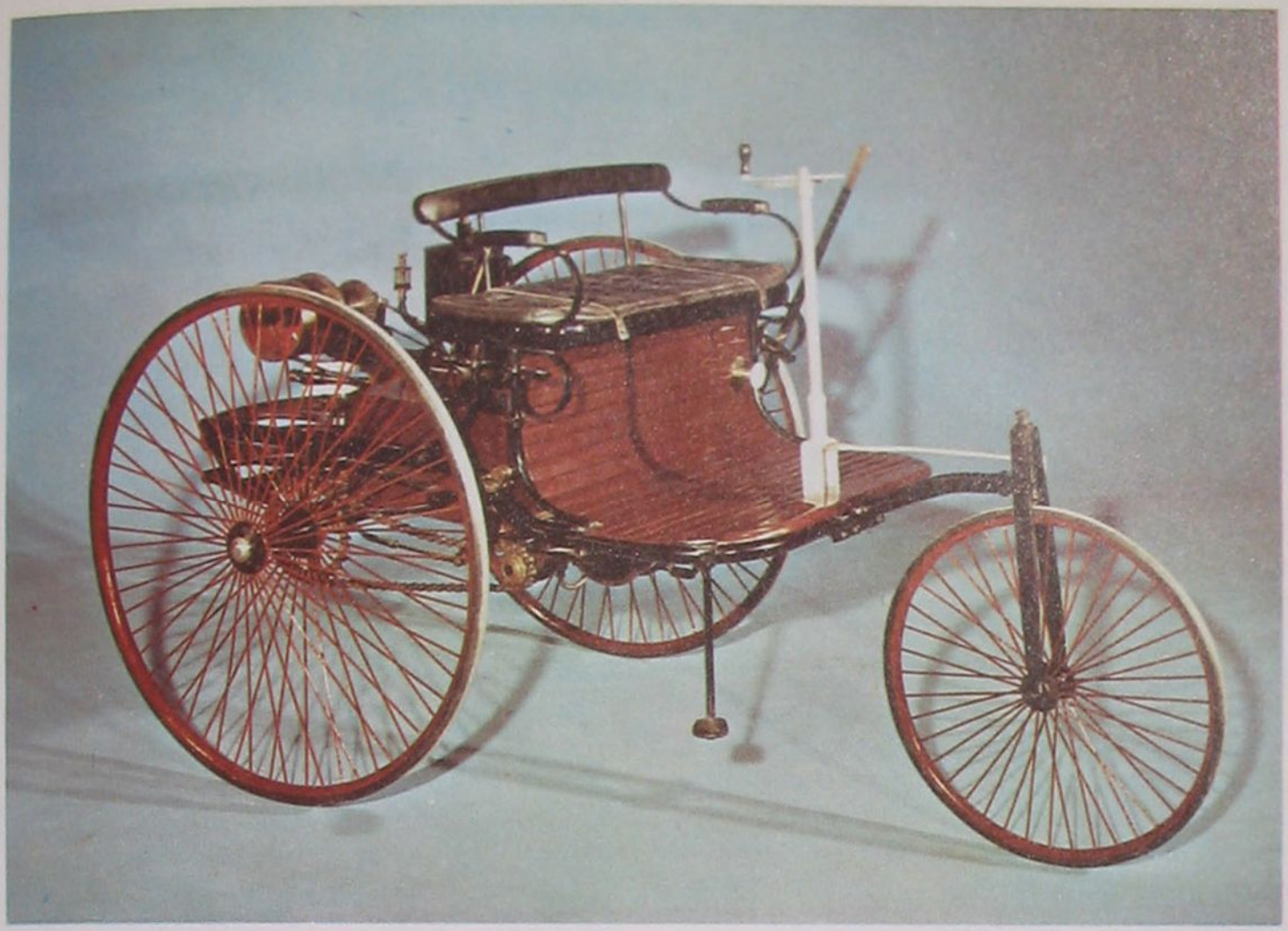
The Vikings were pagans. Odin or Woden was the war god. Warriors killed in battle became immortal; they went to Valhalla, Odin's Hall to feast. Wednesday is his day. Thor, the peasant god, was armed with an invincible hammer and with thunder. Thursday is his day. Viking life was celebrated in prose and poetry, such as the 'Vinland Sagas', the 'Edda', and 'Burnt Njal'.

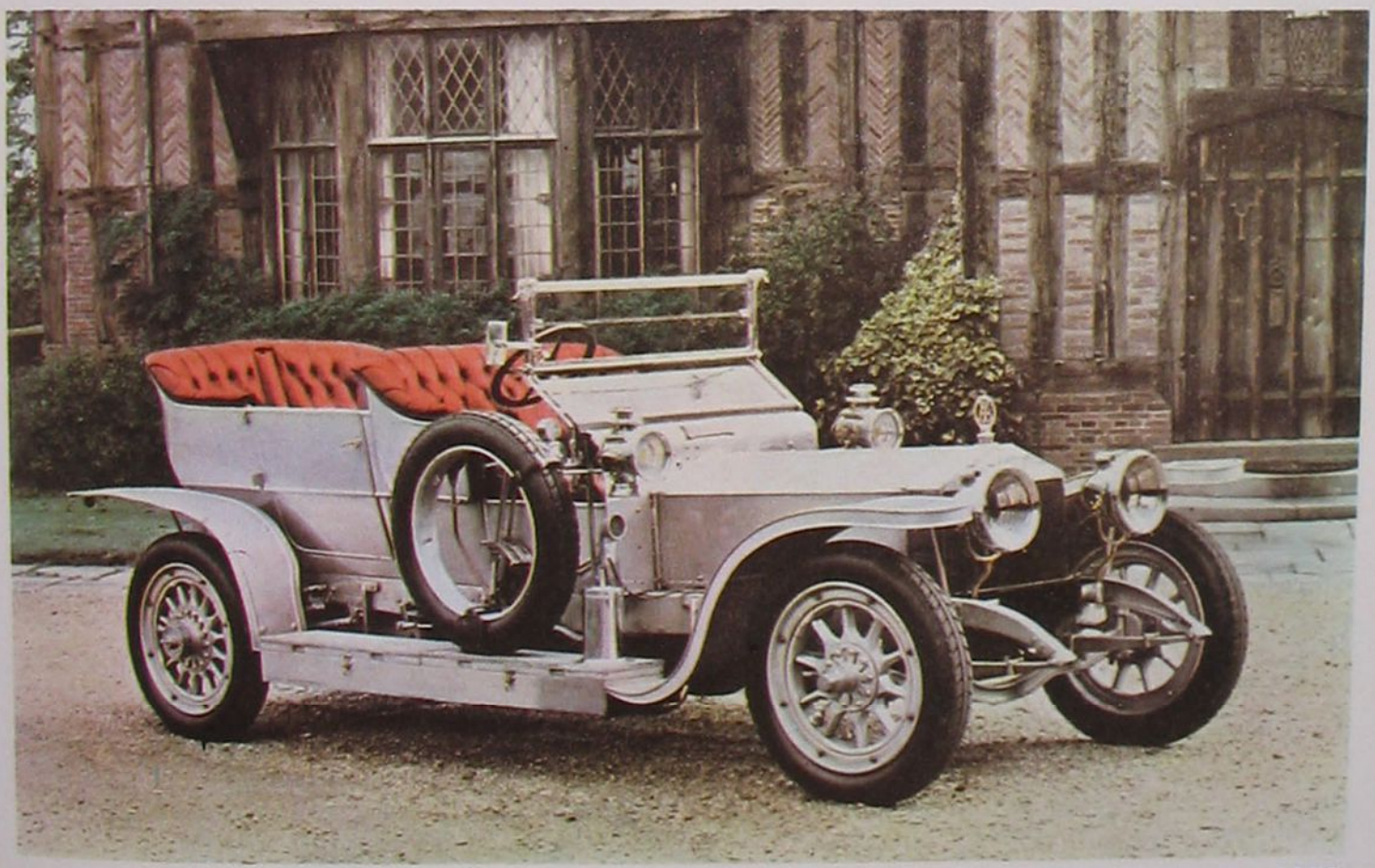
Vinland is the name that Viking explorers gave to a region of North America that they discovered. It was on the north-east coast, in the region of present-day Labrador. The Vikings arrived there about A.D. 1000. They were probably the first Europeans to reach America. Christopher Columbus, who is called the 'discoverer' of America, did not voyage there until 1492. The Vikings named the region *Vinland* because of the wild vines growing there.

According to Viking sagas (legends), Leif Ericson, son of Eric the Red, found the continent by accident. He and his men had settled in Greenland. On one occasion, sailing back to Greenland from Norway/Denmark they lost their way in the heavy sea mist, and landed in Vinland. There they found a wild climate and good soil. They settled there but later left, perhaps because of trouble with Indians.

Vintage and Veteran Cars are valued today for their fine craftsmanship and beautiful and often ingenious design. They are roughly divided into Veteran (cars

Opposite, above: The Benz Patent Motorwagen of 1886. This very early three-wheeled car shows the strong influence of carriage building. Below: The 1907 Rolls-Royce 'Silver Ghost'. This make of car is famous for its superb engineering which has never been rivalled.





built before 1905), Edwardian (1905-1918), Vintage (1919-1930) and Post Vintage Thoroughbred (1931-1940 cars of high quality).

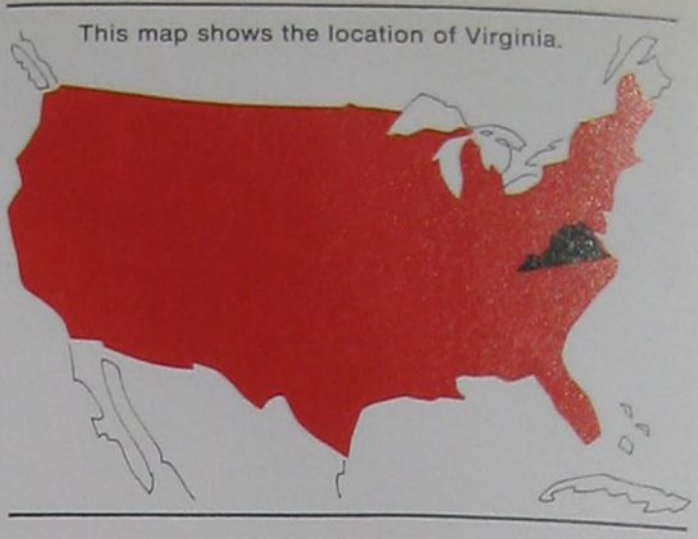
All Veteran, and many Vintage and Thoroughbred cars were almost completely handbuilt using the best materials and the same construction methods used for coachbuilding.

The first cars to be sold to the public were German. Karl Benz's vehicle, marketed in 1885, and built like a tricycle, was powered by a single-cylinder engine. About ten years later, French engineers produced cars with solid tyres, that looked like horse-drawn carriages. The two British engineers Rolls and Royce exhibited their superbly built 'Silver Ghost' at the 1907 Motor Show and set standards which have never been surpassed.

In the U.S., Henry Ford, perhaps the most famous name in motoring, pioneered cheap, mass-produced cars beginning with his Model T—the 'Tin Lizzie' (see Henry Ford). Cheap motoring in Britain came only in the 1920's when William Morris (later Lord Nuffield) produced Morris Cowley and Morris Oxford cars.

Between 1925 and 1942, several fast, luxurious models were built. Great makers included Rolls-Royce (Britain); Bugatti, Delage (France); Hispano-Suiza (France and Spain); Minerva (Belgium); Mercedes-Benz (Germany); Isotta Fraschini (Italy); and Duesenberg (United States). Some of these cars originally cost more than £10,000—an enormous sum for the times. In Britain, owners of veteran cars can drive their vehicles in the London to Brighton race held each November.

Virgin Islands are a group of about 100 small islands in the West Indies. Many are uninhabited. The eastern islands are a British colony. They include Tortola, Virgin Gorda, and Anegada. The western islands were purchased from Denmark by the United States in 1917. They include St. Croix, St. John, and St. Thomas. The islanders rear cattle, and grow sugar-cane, fruits and tobacco.


This map shows the location of Virginia.

Virginia is a southern state of the United States. The state attracts many visitors who come to see the battlegrounds of the War of Independence and the Civil War. The state was named after Queen Elizabeth I, the 'Virgin Queen'.

Virginia covers an area of 40,815 square miles and has 4,648,500 inhabitants. The port of Norfolk, on the Atlantic coast, is the largest city. Richmond, several miles inland, is the state capital.

Tobacco has been the leading crop since the 1600's. Maize and fruit are also grown. Coalmining and fishing are long-established industries, but in recent times industrialization has increased. Factories produce a wide range of goods, including chemicals, electrical equipment, synthetic fibres and other textiles.

The first permanent English settlement in North America was made at Jamestown in 1607. Virginian statesmen were very active in the revolt against Britain, and four of the first five U.S. presidents came from that state. Virginia is sometimes called 'The Mother of Presidents'. It became a state in 1788. It fought with the South in the Civil War.

Viruses are considerably smaller than bacteria, and are visible only under an electron microscope, which is a hundred times as powerful as an ordinary optical microscope. A virus is an extremely simple form of life, so simple that it cannot be called either animal or plant. And scientists even disagree

as to whether it should be considered living or non-living. One of the strange things about viruses is that they are able to multiply only inside the tissues of a living 'host'. The host may be a bacteria, a plant, or an animal. The viruses damage the host by interfering with the working of the body and thus causing infectious disease. In man, viruses may cause the common cold, influenza, measles, poliomyelitis, smallpox, yellow fever, and other complaints. A disease-producing virus always causes the same disease. For example, the virus which brings on polio will cause polio in every person it infects. It will never produce the symptoms of measles instead.

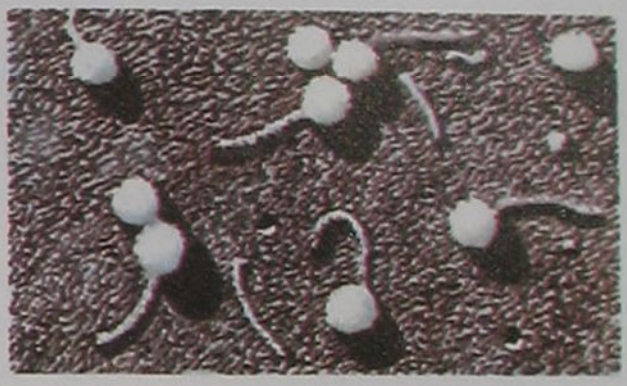
Viruses are formed of nucleic acid (an extremely complex substance) surrounded by protein and lipids (fat-like substances). Infection results from the release by the virus of a substance which is part of its nucleic acid, into cells in the host tissues.

The viruses that attack animals are spread by insects, by physical contact, or through the air, inside droplets of water. This last means of spreading infection is the reason why the use of handkerchiefs is so important: the viruses are driven out in clouds when an infected person sneezes, and may easily be inhaled by another person.

But besides suffering their attacks, man has succeeded in turning some viruses to his own use. In order to rid the countryside of dangerous or unwanted insects, scientists have introduced viruses that infect and kill such troublesome pests. Viruses are also used to prevent disease. By inoculating people with a weakened strain of a certain virus, the doctor can make them immune to that virus. If the people come into contact with that virus later, they will not become ill (see Inoculation).

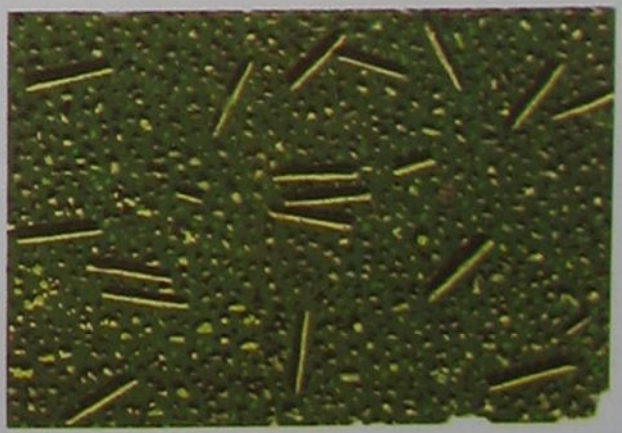
Vitamins are chemical substances necessary for growth and good health. They cannot be manufactured by the body, but must be obtained from food.

Poliomyelitis virus particles, magnified many thousand times, shown inside an infected cell.



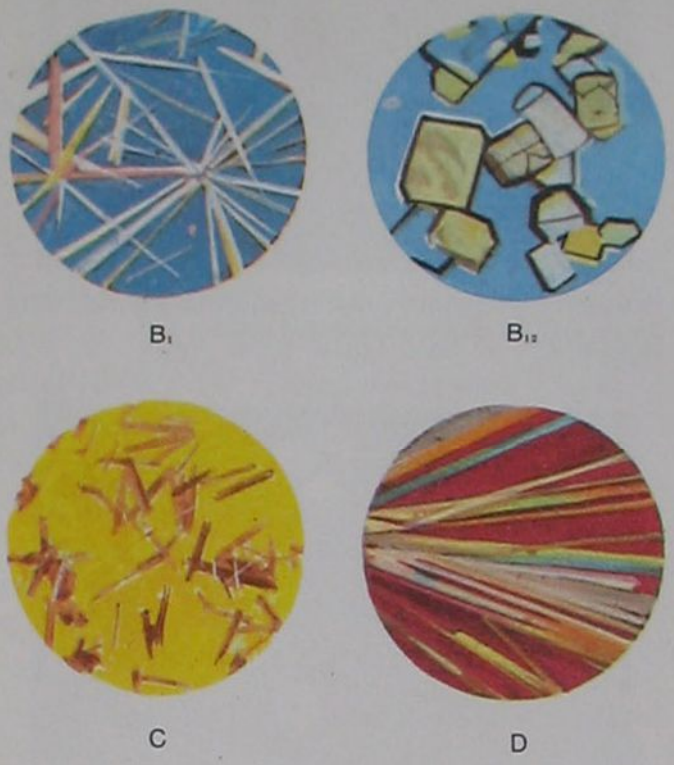
This bacteria virus only attacks bacteria. It has been magnified many thousands of times with the aid of an electron microscope.

Aucuba mosaic viruses are like long thin fibres. They cause mosaic disease in tomato plants.



Tobacco mosaic viruses are rod-like structures about one four-thousandth of a millimetre long (magnification here × 30,000).

Crystals of vitamins highly magnified



Vitamins are classified by letters: A, B, C, etc. Vitamin A is important for growth. Experiments on animals have shown that, if this substance is lacking in their diet, they fail to grow, and gradually lose their appetites. Vitamin A is also an essential factor in certain chemical reactions taking place in the eye. Without it, human beings suffer from 'night-blindness', which means that they are unable to see in dim light. Good sources of vitamin A are carrots and other yellow vegetables, butter, cream, eggs, and fish-liver oils.

The B-vitamins are a large group, some of which are known by their scientific names, such as thiamine, niacin and riboflavin, and others by numbers such as vitamin B_{12}. The vitamin B group are involved in most of the chemical reactions that go on in the body. Lack of B-vitamins means that the body cannot function properly and various diseases result. A lack of thiamine, for example, causes beri-beri, which affects the nervous system and the heart. Milk, eggs, meat, fruit and vegetables contain B-vitamins.

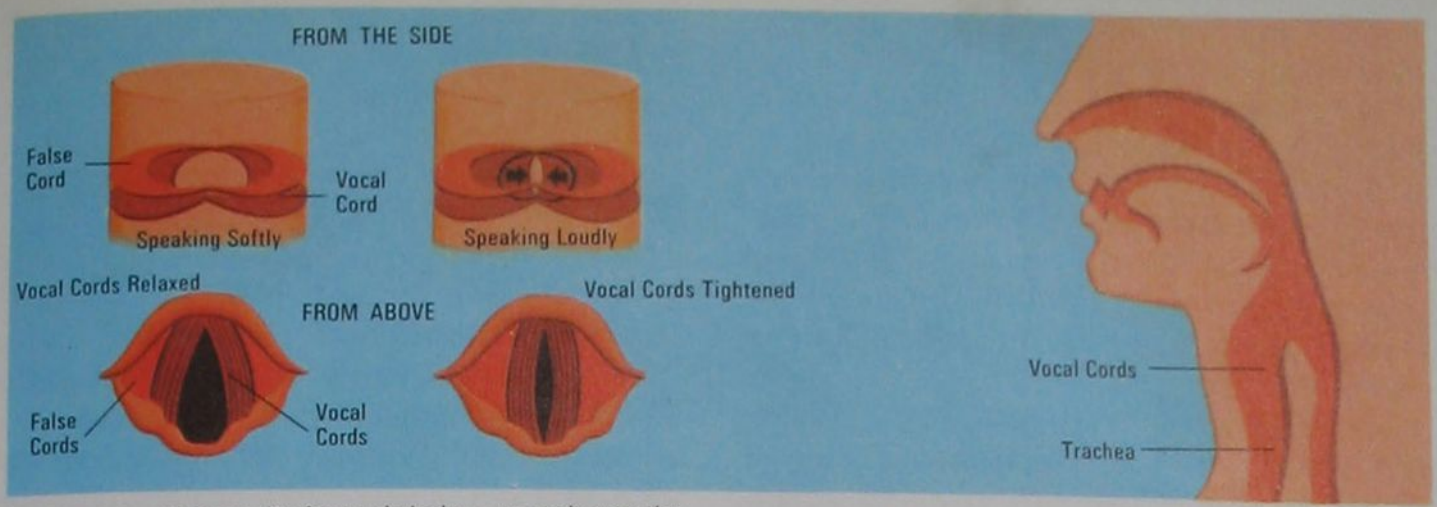
Vitamin C, or ascorbic acid, is necessary to keep small blood vessels healthy. The following is a contemporary account of what happened on board a ship in 1535, and what can still happen to anyone who is missing vitamin C from his diet: "Some did lose all their strength, and could not stand on their feete, then did their legges swel, their sinnowes shrink black as any cole. Others had their skins spotted with spots of blood of a purple colour . . ." This is a partial description of scurvy, a disease which can be prevented by eating fresh fruits and vegetables, which contain vitamin C.

Vitamin D has been called the 'sunshine' vitamin. This is because, on exposure to the sun, certain chemicals found in foods and in our bodies are changed into vitamin D. Milk and bread that have been irradiated (exposed to light) contain this vitamin. It is also found in fish oils. Vitamin D is necessary for bones to grow straight, and also helps to prevent tooth decay.

Vitamin K must be present in the body in order for the blood to clot properly when a person suffers a cut or scrape. This vitamin is manufactured by bacteria in the intestines, but it is missing in newborn babies, who are sometimes given a vitamin K substitute to safeguard them until their bodies begin to receive a natural supply.

Voice is produced in the *larynx*, or voice-box, a box of cartilage in the throat that can be felt as the Adam's apple. It forms part of the wind-pipe. Two thin bands of tissue are stretched across it, one on each side of the opening. Muscles contract (shorten) and relax (lengthen) these so-called *vocal cords*. When we make sounds, these muscles narrow the opening by

Men's voices are generally an octave lower than women's, and the treble voice of a boy is roughly the same as a soprano. Most men are capable of producing a falsetto voice, usually more restricted than their normal one, but this ability is often developed for use in cathedral and church choirs and in male voice groups.



The human voice results from air being passed over the vocal cords while breathing out, causing them to vibrate.

pulling on the vocal cords. As air from the lungs passes through the larynx, it makes the cords vibrate. The result is audible sound.

The *volume*, or loudness, of the sound depends on the force with which the lungs push up air. The *pitch* of the sound depends on the length of the cords. The tighter they are pulled, the higher the sound produced, and *vice versa*. Women generally have shorter vocal cords than men; that is why their voices are pitched higher. Up to the age of puberty, boys and girls have larynxes of the same size—and voices of the same pitch. Then, a boy's larynx grows larger and his voice breaks.

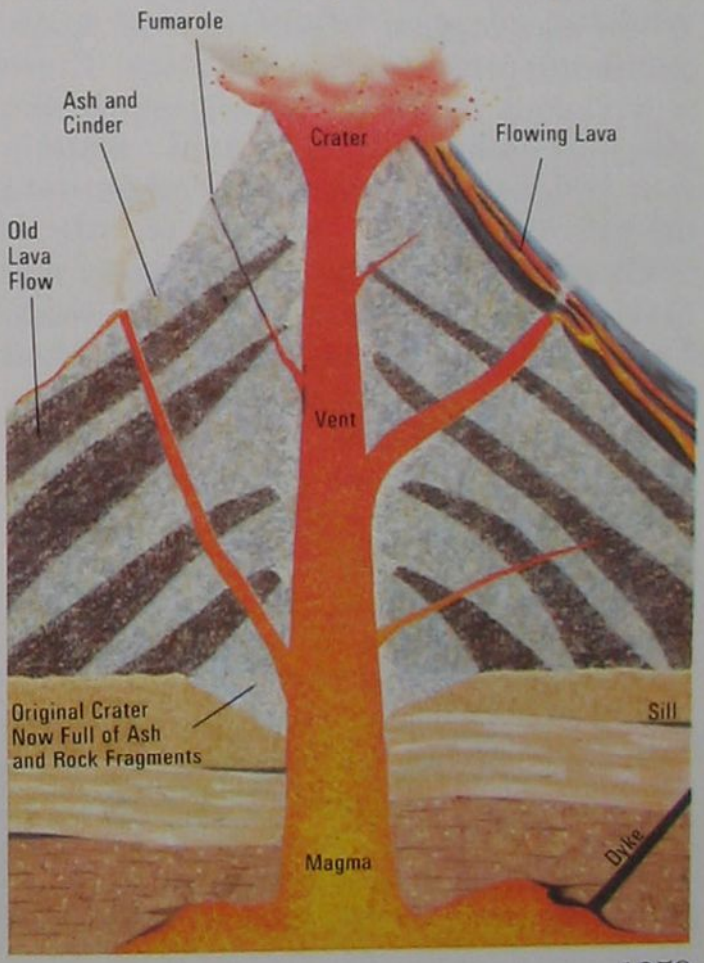
The vocal cords can produce only simple sounds of varying pitch. Different vowel sounds are produced by varying the shape of the mouth cavity. Consonants are formed by changing or interrupting the air flow through the throat and mouth.

Volcanoes There are many types of volcanic activity, but the term *volcano* is usually restricted to those cone-shaped mountains which periodically shoot out *lava* and hot ashes.

Lava is molten rock *(magma)* which was previously situated in pockets in the solid rock beneath the Earth's surface. It contains a high proportion of gas which is lost to the surrounding air when the magma is ejected. The rock formed when lava solidifies is therefore usually very *porous* (full of holes).

It was once thought that volcanoes occurred because beneath its surface crust the Earth consisted entirely of a hot, seething mass of magma which erupted through weak points in the crust. We now know that this cannot be the case, because it is most unlikely that there are any really large masses of molten rock within about 1,800 miles of the surface.

A simplified section through a stratified volcano.



It is significant that almost all active volcanoes are found in regions that are undergoing earth movement, which is probably connected with the formation of mountain ranges. It has been suggested that friction between moving rock masses heats and melts the rock, which then proceeds towards the surface through fissures and lines of weakness in the crust.

The explosive force of an eruption is due mainly to the violent expansion of steam and other gases released from the magma as it nears the surface. When a volcano is first formed, the exploding gases may form a crater of considerable size. The broken rocks and cinders usually fall around the mouth, forming the typical mound *(ash cone)*.

If the lava contains a lot of silica, iron and magnesium, it is 'mobile' and flows freely. Continuous eruption of this type of lava forms volcanic cones with shallow slopes.

Between eruptions a volcano is said to be *dormant*. When an eruption ceases the lava solidifies in the central *vent*. When the magma begins to rise again, enormous pressures are built up. There is a violent explosion which expels the *plug* of solidified lava and scatters rock fragments, dust and ashes into the air.

There are many ancient volcanoes that have not erupted for millions of years. These are said to be *extinct*. It often happens that the *volcanic plug* is harder than the surrounding rock, and after a long period of erosion stands out as a *volcanic neck*. Edinburgh Castle is built upon such a structure.

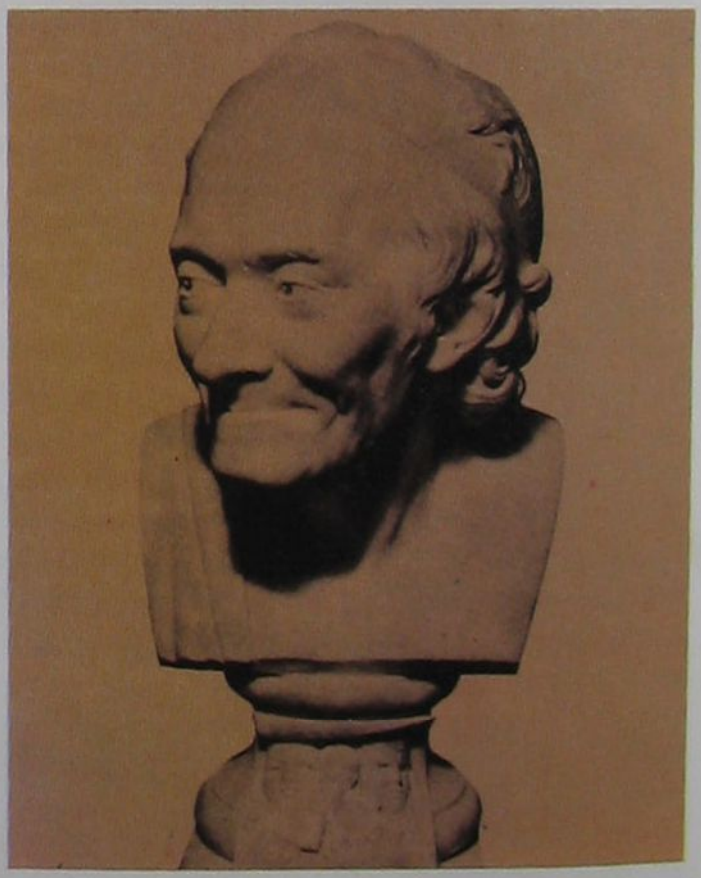
Another important type of volcano is the *fissure eruption*, in which lava wells up along cracks in the Earth's surface and may cover vast areas of land. Such lava flows contract on cooling and form characteristic six-sided columns of basalt, just as the mud of a dried-up pond forms six-sided plates.

A huge area of this 'plateau lava' must have existed to the north and west of Britain; remnants of it are found in Greenland, Iceland, Scotland and Ireland. The Giants' Causeway in Northern Ireland and the rocks of the Isle of Staffa both show this typical six-sided form.

Volga is the longest river in Europe. It is 2,290 miles long and drains more than half a million square miles of middle and east European Russia. The Volga rises in the Valdai plateau, 200 miles south-east of Leningrad, and empties into the Caspian Sea through a 70-mile-wide delta.

Ships can usually sail along nearly all of the river's course, but for three months of each year most of it is frozen. It is possible to sail along the Volga from the Black Sea to the Baltic, by means of a linking system of canals. With its branches it provides 20,000 miles of waterways.

Voltaire (1694-1778), a French writer and philosopher, is noted for his wit and the brilliance of his mind. He championed the common people, and was among the



A bust of Voltaire in old age.

In 1759 Voltaire wrote what is often considered to be his best work, Candide. It is a satirical novel based on the travels of the young man Candide around the world accompanied by his incurably optimistic friend Pangloss. Together they encounter all kinds of misfortunes on their journey, and Voltaire uses the story as a medium for expressing his own philosophy of the world.

writers whose works influenced the course of the French Revolution.

Voltaire was the pen name of François Marie Arouet. His father, a civic official, wanted him to practise law. But Voltaire was a spirited young man who preferred to earn his living as a writer.

When he was 23, he was imprisoned in the Bastille for writing a poem which *lampooned* (made fun of) a powerful noble, the Duke of Orléans. Six years after his release, he was back in the Bastille again, this time because of a quarrel with another powerful noble, the Chevalier de Rohan. He was released only on condition that he left the country.

Voltaire spent the next few years in England, where he came to know many of the important writers and philosophers. He was deeply impressed by the fact that in England men were free to think and speak as they chose, while in France men did not have this freedom.

Voltaire returned to France and used his writing to attack the political and social institutions of France. Many of these attacks were directed at the Roman Catholic Church. Voltaire's works included history, drama, and poetry as well as satire and philosophy. He achieved great popularity with the people of France, and his ideas helped to bring about the French Revolution of 1789, in which the king and the old order of things were finally overthrown.

Von Braun, Wernher (1912-), a German-born rocket engineer, led the team of engineers and scientists who designed the United States' first Earth-orbiting satellite. This was *Explorer I*, sent up in 1958. Later he worked on the development of the huge *Saturn V* rockets that were used to put men on the Moon.

During World War II, Von Braun was technical director of the German rocket research centre. He built the notorious V-2 rocket, which the Germans used against London.

Vultures are birds of prey that live mainly on dead animals. They are large birds, and look rather like eagles, with enormous wings, short tails and bald heads. There are two groups, New World and Old World, but they are not closely related.

New World vultures have slightly hooked beaks, and small feet and *talons* (claws) that are not suitable for killing prey. They live entirely on *carrion* (dead animals). Old World vultures are members of the hawk family. Their beaks, feet and talons are all larger and stronger than the New World, or American, species. Some of them kill and eat live prey, in addition to their usual diet of carrion.

All vultures have keen eyesight. They can detect food miles away by watching other hunting birds in the sky dropping suddenly to earth.

In the New World, the condor of the Andes has a wing-span of 10½ feet and weighs 25 pounds. In the Old World, the lammergeyer eats the marrow from inside bones. It drops the bones from the air until they break.

African vultures feeding on a dead zebra. These vultures are about 40 inches long.

W

Opposite: Lake Tal-y-Llyn, Merioneth, in the mountainous heart of Wales.

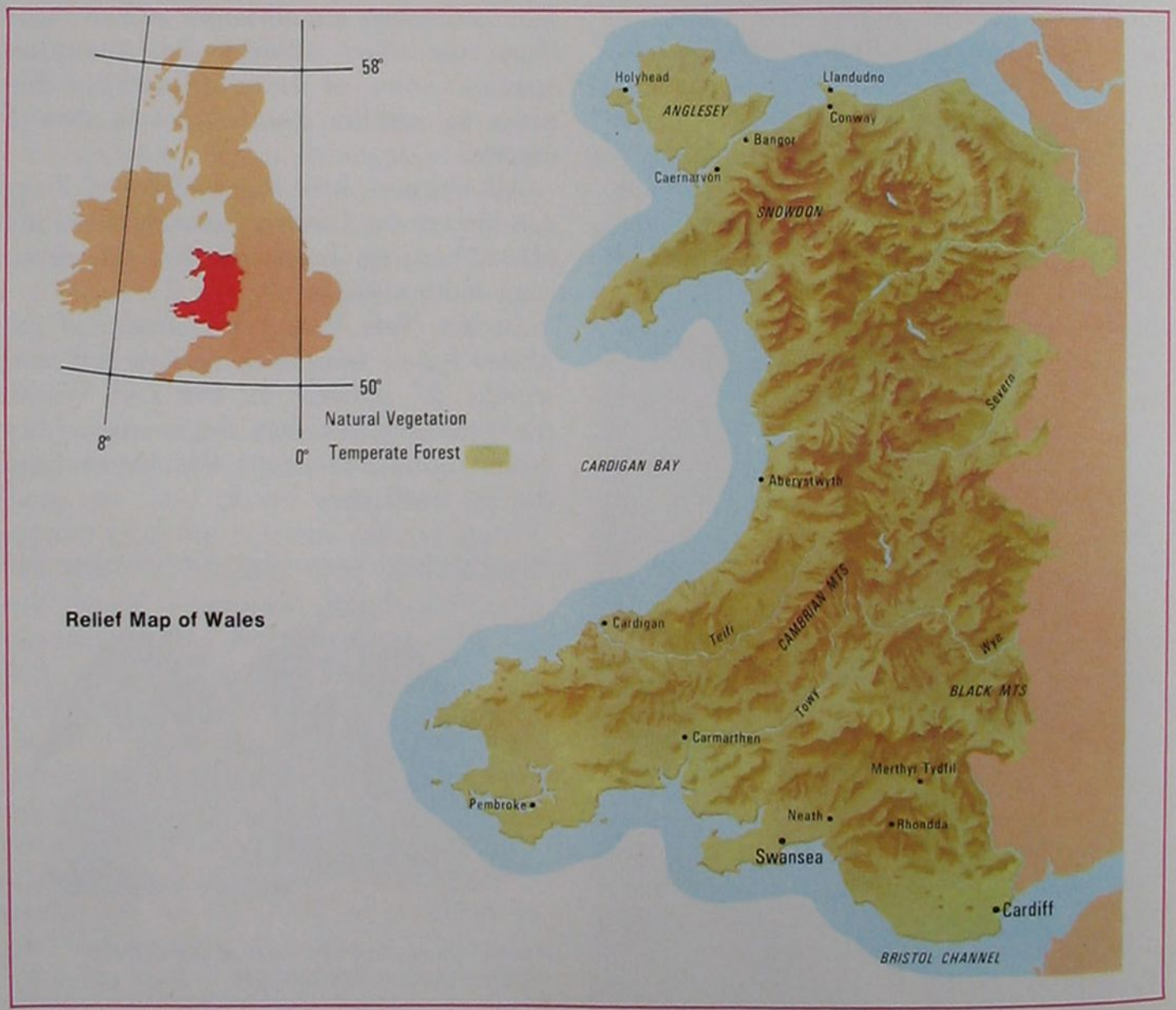
Wagner, Richard (1813-1883), was a German composer, conductor and author who challenged and changed traditional ideas of opera in the 19th century. He endeavoured to combine music, scenery, poetry and acting into one dramatic presentation, with each aspect given equal importance.

Among his greatest works are *The Flying Dutchman* (1843), *Tannhauser* (1843-1845), *Lohengrin* (1850), *The Ring of the Nibelungs* (1876), and *Parsifal* (1882). (The dates refer to the first performances of the works.) In order to stage *The Ring*, a cycle of four operas based on German legends, Wagner built a great theatre at Bayreuth. An annual Wagner festival is held there.

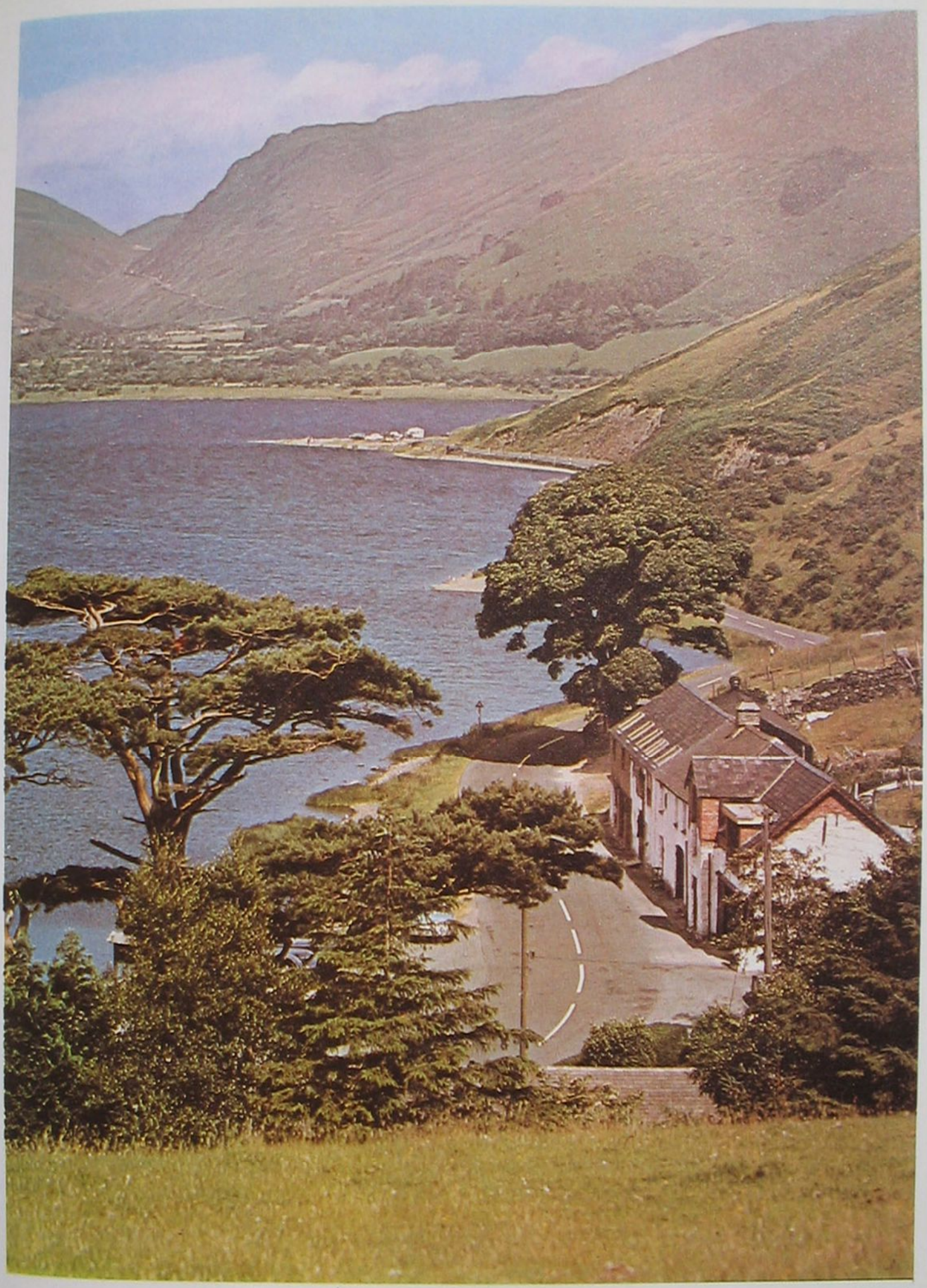
Wales is part of the United Kingdom of Great Britain and Northern Ireland. It covers an area of 8,017 square miles (see British Isles, United Kingdom).

Wales is joined to England along its eastern border. On the north, west, and south it is surrounded by the Irish Sea, St. George's Channel, and Bristol Channel.

Mountains cover the central part of the country, reaching to the English border.



Relief Map of Wales



Much of this area is high, grass-covered hills. In the north lie higher, rugged peaks. The highest is Snowdon (3,560 feet above sea level). Farmers graze cattle and sheep on the hillsides. Around most of the coast lie low, fertile plains. These plains are broadest in the south. In south-western Wales, farmers take advantage of the mild weather in spring and grow early vegetables. Coal lies under the hills and plains in south Wales, and most of the people live and work in that area. People quarry slate in the north. North Wales also has a small coalfield.

Many metal and manufacturing industries are located in the south. Cardiff is the capital and the biggest city.

The Welsh people are mainly Celtic in origin. Most of them speak English, but some speak Welsh, which is taught in schools. The people elect members to the British House of Commons.

The people of Wales were rarely united under one strong leader. Because they were so divided, the English were able to conquer them. In the 1200's, Edward I of England defeated a Welsh leader, Llewelyn ap Griffith, and made himself master of the country. He gave the title of Prince of Wales to his infant son, and eldest sons of the monarch have held this title ever since.

Despite many attempts by the Welsh to rebel, the English retained their hold on the country. In 1485, a Welshman, Henry Tudor, became king of England. In 1536, England and Wales were united (see England). Welsh nationalism won many supporters in the 1960's.

Walrus The walrus is a heavily built relative of the seals (see Seals). It is a mammal that lives in the cold Arctic region. Walruses live in herds on ice-floes and sea-shores, diving into the sea to catch food. They eat mainly starfish, crustaceans such as shrimps, and shellfish, which they catch on the sea-bed.

Walruses grow to a length of more than 10 feet and weigh more than one ton. They have two large tusks—which may reach three feet in length—growing downwards from their upper jaw. Like seals, they have flippers instead of legs. They use them for swimming and to waddle along on land.

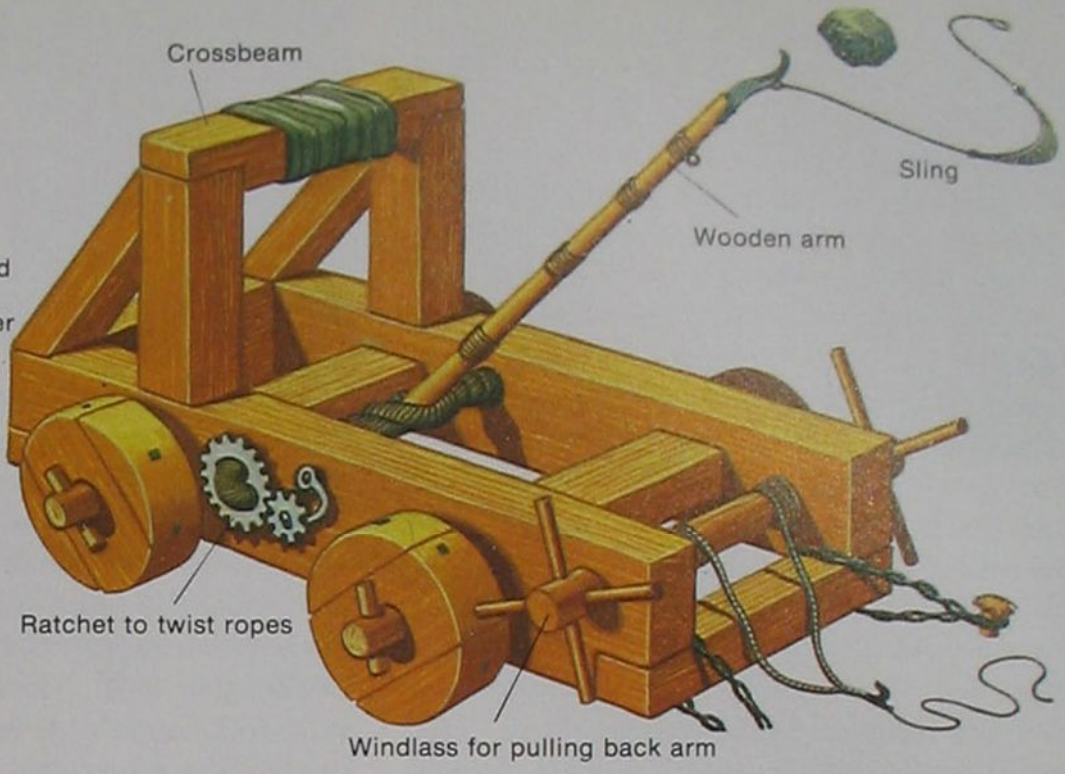
The walrus lives in small herds in the cold Arctic region. There are slight differences between the Atlantic walrus and its Pacific cousin.

Warfare, history of The earliest battles were small tribal affairs, frequently conducted over territorial disputes. It has often happened in the past that one community has envied the more fertile land and better living conditions of another, and has attempted to drive the inhabitants away. Early civilized communities were threatened by wandering barbarians, and from time to time their towns were destroyed and themselves put to flight. Elaborate precautions had to be taken against potential invaders, such as the Great Wall of China, which was built to keep out the Mongol horsemen.

It was soon found that a small, highly-organized force could defeat a much larger untrained rabble. Some countries made use of foreign mercenaries (soldiers fighting simply for pay). Others kept a permanent army recruited from their own citizens. Roman civilization was spread largely by the legions, who subdued most of Europe by defeating other communities in battle.

Although the Romans relied heavily on infantry, they also developed cavalry warfare. From then until the First World War, cavalry played an important part in warfare, and during the Middle Ages a large number of battles were fought

Huge catapults were one of the most effective weapons the Romans and others used to attack cities under siege. At that time, most cities had stout walls around them to stop enemies from getting in. The catapult hurled large rocks which smashed holes in the walls. Later, the invention of gunpowder completely changed the methods of siege warfare.



between men on horseback. Armour grew heavier and heavier, but the development of the longbow spelt the end of the reign of the medieval knight, as the horse was particularly vulnerable, and without his horse the knight was helpless.

Warfare at this time consisted largely of laying siege to castles. An invader had to subdue the castles in his way to avoid having his lines of communication cut. Sieges were often long-drawn-out affairs, since frequently the only effective method of overcoming a castle was to starve the defenders into submission. However, the importance of castles declined with the invention of gunpowder, which gave the attacker a means of breaching the thickest walls.

Up until the eighteenth century, armies tended to be slow-moving and handicapped by ponderous baggage trains. Napoleon used the technique of living off the countryside, and thus enabled his armies to move extremely quickly. He won many of his battles through a rapid series of forced marches which brought his troops where they were most needed. (See Napoleonic Wars.) This period also saw the beginning of military intelligence, and Napoleon was one of the first commanders to keep himself constantly informed of the enemy's disposition.

Britain managed to prevent invasion during the Napoleonic Wars, and at the same time to aid other countries in their fight against Napoleon, by her control of the seas. The French Fleet was shattered at the Battle of the Nile, and finally demolished at Trafalgar. Naval gunnery was still in its infancy, ships had to get side by side in order to fight, and battles were won by superior seamanship and rate of fire.

Greater range and accuracy were achieved in all branches of gunnery with the introduction of the principle of the rifle – spiral grooves in the barrel causing the projectile to spin in flight. This in turn meant that soldiers in bright uniforms became easy targets for the rifleman, and so armies took to dull-coloured uniforms which did not show up so easily. Warfare was further changed by the development of the machine gun. This meant that one man, suitably protected, could hold off a regiment. Artillery, too, was vastly improved, and to survive, men had to dig themselves into systems of

trenches. Trench warfare and massive artillery bombardments led to the stalemate and vast loss of life in the First World War (see World War I). This stalemate was broken by the use of the tank in 1917. When used at the Battle of Cambrai, tanks punched a deep hole in the German line. But the Allies were not quick enough to exploit their advantage and the Germans repaired the damage.

The Second World War was fought in a more flexible fashion (see World War II). The aircraft, in the First World War used for little more than reconnaissance, took over some of the roles of the ship. The whole of the enemy's territories were now open to attack and one of the results of this was the mass bombing of civilians by both sides. Submarines were improved and used to attack surface vessels of all descriptions, while tank warfare gave to land battles some of the features of a naval engagement.

Since World War II, international relations have been dominated by nuclear weapons, which have such devastating effect that by attacking a nuclear power a country is inviting its own destruction. The resulting precarious balance of power is known as the Cold War. It has meant that in recent wars countries have made use of more conventional weapons, preferring to use the more devastating ones as deterrents.

A feature of fighting since World War II has been *guerilla warfare*. Guerilla soldiers do not wear uniform and try to merge in with the local inhabitants. They avoid big battles and only attack small, isolated units of the enemy.

Talking points

* It is sometimes said that there are no winners in a war—only losers. Discuss the reasons why wars occur when no country actually benefits from them.
* Throughout the ages, Man has constantly 'improved' the weapons of war. Today, there are nuclear bombs which are capable of wiping out a large proportion of the world's population. What has caused Man to develop weapons to such a frightening level of efficiency?
* Popular interest in uniforms, weapons and warfare in general has greatly increased over the past decade. Discuss the reasons for this.

Articles to read:

Armed forces; Armour; Articles on wars; Explosives; Guns; History; Tanks.

Warsaw is the capital and most important city of Poland. It has 1,308,000 inhabitants. Lying on the banks of the River Vistula, it is a market town for the surrounding farm district. Agricultural products are processed there. The city manufactures chemicals, precision instruments, iron, steel and heavy transport equipment. Warsaw is an important centre of culture and learning.

Germany invaded Poland in 1939 and conquered the city. Two rebellions against the Germans—one by the Jews and the other by the Polish inhabitants—were put down ruthlessly. By the end of the war, the city was almost completely destroyed. After the war, many modern buildings and skyscrapers were constructed, and old buildings in the city centre, such as the 14th-century cathedral, were rebuilt.

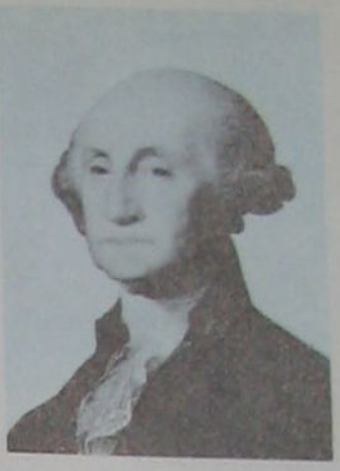
Warwickshire (area 983 square miles), a county in the West Midlands of England, encloses one of the greatest industrial regions in the world. Its county town is Warwick, and its population is 2,079,800.

The southern part of the county is mainly taken up with farming land. Wheat, barley and oats are grown. The fertile valley of the River Avon supports fruit orchards and market gardens. Much of the land is used for dairy farming. The central and southern parts of Warwickshire are drained by the Avon and its tributaries—the Leam, Sowe and Stour. There, agriculture and fruit-growing are the main occupations. Stratford-upon-Avon is world-renowned as the birthplace of Shakespeare. Leamington is a favourite health and holiday resort.

In the north, the land is drained by the River Tame and its tributaries, flowing northwards into the Trent. Coal-mining and the manufacture of machinery, metalwork, and motor cars are at the heart of the industrial life of the region. Birmingham, with more than half the county's population, and Coventry are the two largest and most important towns.

Left: The dome of the Capitol Building, Washington, D.C. Wings of the building house the chambers of the Senate and the House of Representatives.

Right: George Washington while President of the United States.



Washington, George (1732-1799), commanded the army that won independence for the American colonies from Great Britain in the American War of Independence, and was his country's first president. Washington, D.C., the capital of the United States, was named after him, and so was the state of Washington.

Washington was born in Westmoreland County, in the British colony of Virginia. He learnt to manage his father's farm and later worked as a surveyor. When he was 20, Washington was made a major in the army and fought for the English against the French, who had taken possession of the Ohio River Valley. He resigned from the army as a colonel and became a successful farmer at Mount Vernon, an estate he interited from his brother. In 1759 he married Martha Custis, a rich widow. Washington served on the colonial legislature (council) for fifteen years.

American colonists protested more and more as the British made them pay higher taxes. Washington was made commander-in-chief of an American revolutionary army in 1775. The army was poorly trained, fed and equipped. But in 1781 Washington led them to victory over the British at Yorktown, Virginia. Five years later he presided over the conference in Philadelphia that drew up the United States constitution, and in 1789 was elected president in New York. He was re-elected in 1793 and retired four years later.

Washington, D.C. (pop. 756,000) is the capital city of the United States. It is the seat of government (Congress) and of the Supreme court (Judicature) and is the official residence of the President. The city is situated on the Potomac River near its confluence with the Anacostia River, in the Federal District of Columbia. The city was laid out by the French architect Pierre l'Enfant during the Presidency of George Washington, and was the first city to have been specially planned and built as a national capital. It is a city of great beauty with many noble buildings.

Washington is a state in the extreme north-west corner of the United States. It is sometimes called the 'Evergreen State' because of the forests that cover about half of its 68,192 square miles. The great Columbia River flows along the state's southern border into the Pacific Ocean and its large dams, such as the Grand Coulee, provide hydro-electric power and

This map shows the location of Washington State.

irrigation for the dry eastern part. Washington has 3,409,000 people. Olympia is the state capital.

Important industries in Washington produce aircraft and aircraft parts. Others process the state's natural resources. They produce sawn lumber and pulp. Dairying and livestock rearing are important farm activities. Wheat is the principal cereal and there are many apple orchards.

Originally both Britain and the U.S. claimed the area that is now Washington. War was avoided by a treaty, signed by the two countries in 1846, establishing Washington's northern boundary. In 1849, Washington became a state.

Wasps are insects related to bees and ants. Wasps can inflict a painful sting when disturbed, but their black and yellow stripes serve as a warning to animals and humans.

There are two main kinds of wasps, *solitary* wasps and *social* wasps. The solitary wasp lives alone, and makes a small nest for its young. The nest may be simply a hole in a tree or a hole dug in the ground, but some solitary wasps build small nests made of earth, or mud and pebbles, stuck together with saliva. The female wasp builds the nest and gathers food. The adult wasps feed on nectar, fruit, and other sweet juices, but the larvae eat animal matter. The female paralyses a caterpillar, beetle, or some other insect with her sting, and takes the live body to her nest. She lays her eggs on the insect, so that the growing larvae will have a supply of fresh food. The young wasps live through the winter as larvae or pupae and emerge in the spring as adult wasps.

Ammophila, a hunting wasp, buries a caterpillar and lays eggs in it. When the eggs hatch the larvae will have plenty of food.

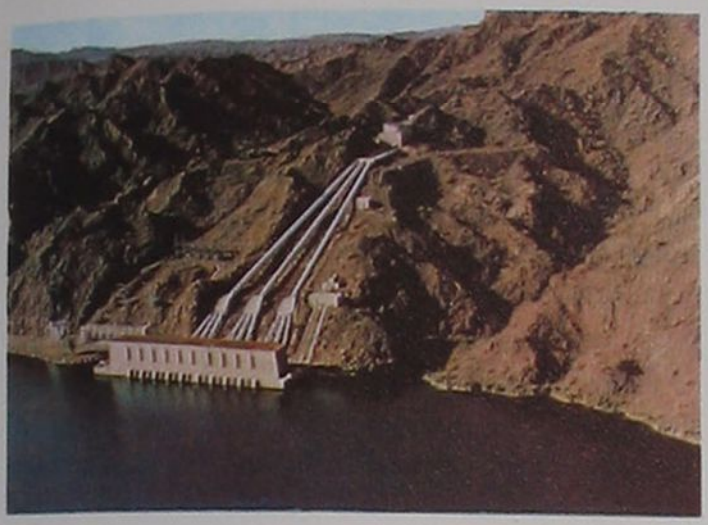
Social wasps live in colonies, like honey bees. But a wasp colony lasts for only one season. The *queen* wasp heads the colony. She hibernates through the winter and starts a new colony in the spring. She builds the first layer of a nest with paper made by chewing wood to a pulp. She lays eggs in this layer, and feeds the larvae on chewed insects. These larvae become *worker* wasps. The workers build up the first layer into a large paper nest containing many six-sided cells. The queen continues to lay eggs and the workers take over the job of looking after the nest and larvae. New queen wasps develop later on in the year. They mate with males and then look for somewhere to hibernate. The other wasps all die.

The common yellow wasp is a social wasp. Its egg-shaped paper nests can sometimes be seen hanging in trees or hedgerows, although they are usually under the ground.

Water is one of the commonest substances on Earth. It falls as rain and makes up rivers, lakes and oceans. It is essential for life—plants and animals soon die if they get no water. Yet to the scientist water is just another chemical compound. It is a colourless, tasteless liquid formed when hydrogen burns in air or oxygen. Chemically, it is an oxide of hydrogen and has the formula H_2O.

Cooled below 0° C (32° F), water freezes to form solid ice. Ice is less dense than water so it floats. This property is a nuisance to man because floating icebergs and pack-ice are dangers to shipping. But it is useful to fish which can continue to swim about in rivers and lakes even when a thick layer of ice forms on the surface.

When heated above 100° C (212° F),



Above: The Water Cycle. Water evaporates from the ocean in the form of vapour. Blown inland by the wind, it condenses in the form of rain or snow. It then begins its journey back to the sea again in lakes and rivers.

Water Supplies

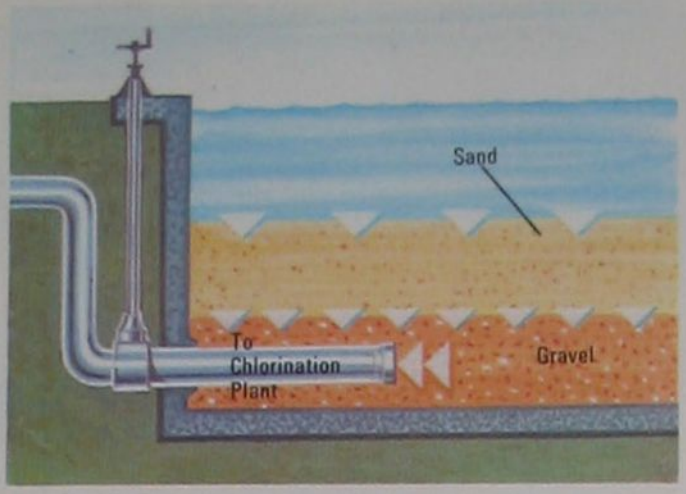
Left: Whitsett intake pumping plant, on the Colorado river.

Below: Water flows through the control gates on the California Aqueduct.

Bottom: Water being carried in a canal through the open desert.

water boils to form a colourless vapour called steam. (The white clouds we see near a kettle of boiling water are not really steam but clouds of tiny water droplets; real steam exists in the scalding hot invisible area between the end of the kettle's spout and the white cloud.) Like all gases steam exerts a pressure and engineers make use of it to drive the pistons of steam engines and the blades of steam turbines.

The water in the world is continually on the move. Three-quarters of the Earth is covered by ocean and the action of the Sun's warmth makes ocean water evaporate to form vapour. The water vapour rises and, when it reaches colder layers of air, condenses to form water droplets which we see as clouds. When the droplets get large enough they fall as rain, which drains into streams and rivers and eventually flows back to the oceans. This great circle of events is called the *water cycle*; because of it the amount of water on Earth does not change, it merely



In a filtration plant, water is passed through beds of sand and gravel, which remove most of the impurities.

moves around. The amount of water involved is staggering. Fifteen million tons of water are evaporated every second.

Water supplies Vast quantities of water are needed in this modern world for use in the home and in industry. A city such as London, for example, uses about 600 million gallons of water every day.

Most of our water comes from rivers. And these may sometimes have to be dammed to store enough water to provide a constant supply all the year round. (See Dam.) In some regions the water supply comes from wells and boreholes.

River water is dirty and may contain bacteria which cause disease. It must be treated in various ways before it is fit to drink. First, water is pumped from the river into an artificial storage lake, or *reservoir*. In the reservoir, dirt in the water settles out and many of the bacteria die.

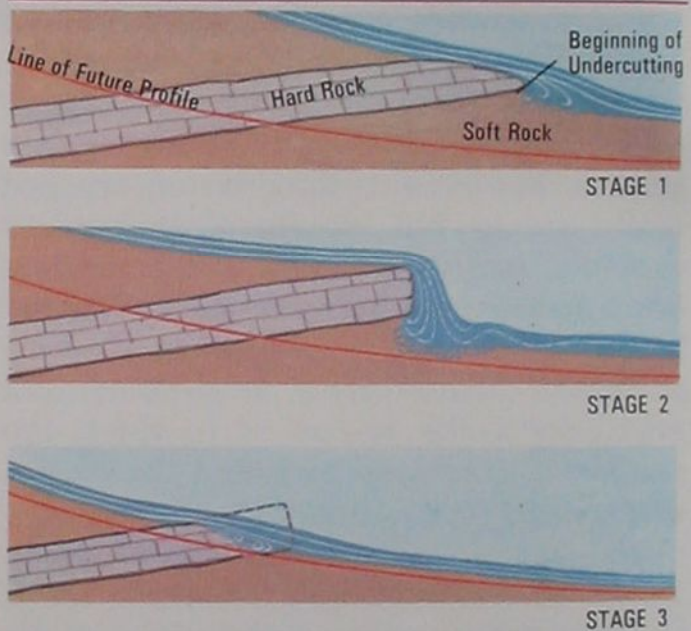
From the reservoir, the water passes to a *filtration plant* where beds of sand and gravel remove more dirt and bacteria. The water finally goes through a *chlorination plant*, where chlorine gas kills any remaining bacteria. The water is now fit for drinking and is pumped into the public water mains.

The increasing shortage of water in the world has made scientists look to the sea as a future large-scale source of fresh water. Sea water normally, of course, is unfit to drink because it contains large amounts of salt. *Desalination*—removing the salt—is not difficult, but it is expensive.

Waterfalls form when a river flows suddenly from a hard rock to a soft rock. The river wears away the soft rock much more quickly than the hard rock, and a kind of 'step', or ledge results.

Often a series of ledges are formed, over which the water flows more rapidly. They are, appropriately enough, called *rapids*. Rapids can be seen in practically any mountain stream. When the rapids are steep and extensive, they are called *cataracts*. There are some splendid but very dangerous cataracts in the upper reaches of the Nile and Congo rivers, both in Africa.

The name cataract is also given to falls that discharge large volumes of water. Niagara Falls on the River Niagara, be-



Where a hard band of rock is followed downstream by a softer one (such as shale or clay) the latter is worn away much more quickly and a steep slope results. The river runs down this as a rapid. Where the dip of the rock is such that the hard bed can be undercut a vertical face and a water fall can result. This fall must be removed before the river can reach the graded condition. As the water crashes over the fall it erodes the softer material and leaves hanging pieces of hard rock. These fall away and the falls recede upstream, leaving a gorge in front of them.

As the falls recede they will reach a position where the base of the hard rock meets the future grading line. There will be no more undercutting and the falls will deteriorate into rapids and then disappear altogether.

Waterfalls are often very beautiful. The picture shows Rouna Falls near Port Moresby, Papua—New Guinea.

tween Canada and the United States, is a cataract. It actually consists of two separate falls—the American and Horseshoe falls. Another cataract is Victoria Falls on the River Zambezi, between Zambia and Rhodesia, in Africa. It is about a mile wide and discharges a million gallons of water a second in the rainy season. The famous explorer Dr. David Livingstone discovered the falls in 1855.

Both the Niagara and the Victoria Falls are magnificent spectacles. A permanent cloud of spray hangs over them, and the noise is deafening.

A waterfall with little water flowing over it is often called a *cascade*. Some of the highest falls in the world are cascades. The highest is Angel Falls, in Venezuela, with a total drop of 3,212 feet.

Watt, James (1736-1819), was a Scottish inventor and engineer. He made many improvements to existing steam engines, which at that time were simple in design.

Watt began his working life making scientific instruments, and was later employed in this capacity by Glasgow University. He worked on several canal surveys, including the Forth and Clyde and the Caledonian. He also improved harbours, such as those at Ayr and Greenock, and helped to deepen rivers, including the Forth and the Clyde.

Watt had for some time been interested in the further possibilities of steam engines, and in 1763 he repaired a model of the Newcomen type. This was a steam engine used for pumping water from the mines. Watt easily repaired the engine. And, noticing the defects, he set out to improve it.

The Newcomen engine used a lot of fuel, and was not capable of producing much power. The engine that Watt in-

James Watt, from an old engraving. His inventions enabled the steam engine to serve all kinds of machinery, with the most far-reaching results. The *watt*, the unit of electrical power, was named after him.

vented was designed to eliminate the wastage of heat and steam. In this way, the cost of running the engine was greatly cut. Watt continued to make improvements on his engines, and in 1769 took out his first patent.

He formed a successful partnership with a Birmingham manufacturer called Matthew Boulton. They set up a company together which produced the new engine. Watt's engine was soon preferred to all those in use and took over in the mines as a pumping machine. (See Steam engine.)

Watt invented many other vital new parts for the steam engine, all of which paved the way for its much greater use in the following years. Among his other inventions were a screw propeller for ships, and a micrometer, for measuring very small distances or angles. The unit of electrical power, the *watt*, is named after him.

Watt is a unit used to measure electrical power. The higher the wattage, the faster the rate at which work is or can be done. Wattage is found by multiplying the *amperes* (strength of current) by the *volts* (electrical force) involved. Light bulbs are normally rated by watts. A 100-watt bulb, for instance, uses up twice as much power as a 50-watt and gives off more light.

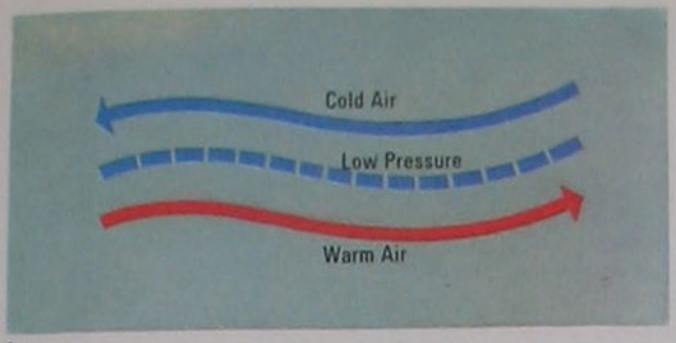
The power produced by a generator is usually expressed in larger units called *kilowatts*. One kilowatt is equal to 1,000 watts.

Weasel The weasel is a small flesh-eating mammal closely related to the stoat (see Stoat). But weasels are smaller than stoats, reaching a length of only 10 inches, including a 2½-inch tail. Like stoats, they have slim bodies, short legs, and pointed heads.

Weasels have rust-brown fur along their backs, and white underparts. Unlike the stoat, the common weasel of Asia, Europe and northern Africa has no black tip to its tail. Weasels live in a disused rabbit burrow, a hollow tree, or a similar place. They are quick hunters, killing such small mammals as rats and mice, and also eating frogs and small birds.

Weather is the day-to-day condition of the atmosphere at a particular place. It is concerned with such factors as temperature, air pressure, wind, cloud, humidity (dampness), rain, snow, frost and visibility. The typical weather of a region over a long period is called the *climate*.

The weasel is a close relative of the stoat and the polecat. In cold regions certain species turn white in winter. The short-tailed weasel, which lives in North America, is important as a source of ermine.



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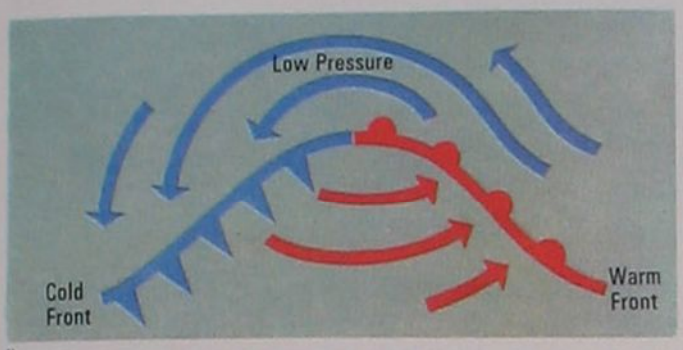

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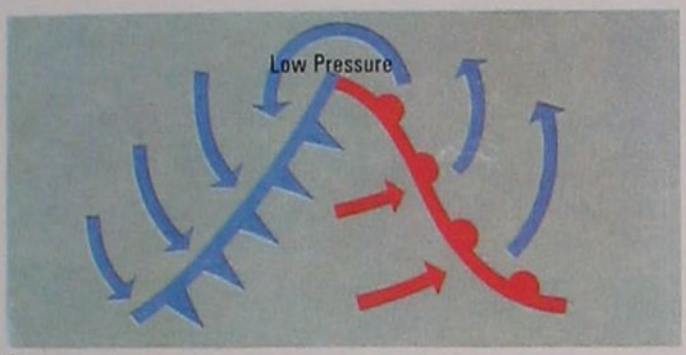

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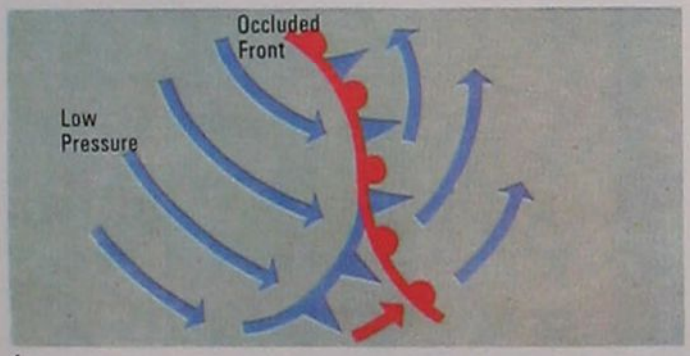

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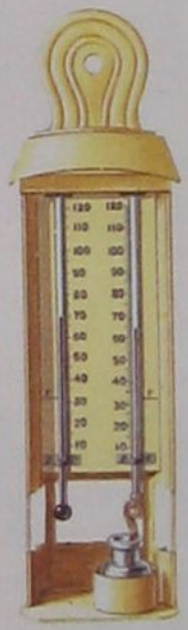
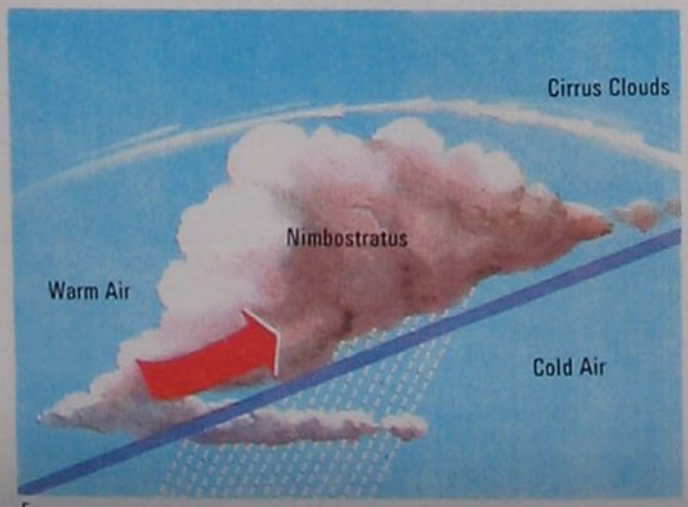
Life as we know it is possible because our Earth has an envelope of air round it, hundreds of miles thick, called the atmosphere. The world's weather depends on conditions in the lowest layer of the atmosphere, called the *troposphere*, which is only about 10 miles thick (see Atmosphere).

Weather is caused by a number of factors. Those parts of the Earth near the Equator receive more heat from the Sun than those near the Poles. This unequal heating of the Earth's surface produces movements of air – the winds. There is a simple world pattern of winds caused by the rotation of the Earth, but it is greatly upset by the existence of continents and oceans, by the shape of the land masses, and by temporary 'cells' of high and low pressure (see

The Life Cycle of a Depression
1. A wave in the polar front.
2. Cold air wraps around the back and two distinct fronts develop.
3. Cold air begins to overtake and burrow under the warm air.
4. The warm part is gradually lifted off the ground and the depression is occluded.
5. **A Warm Front**
Warm air overtakes and gradually rises over the colder air.
Clouds form and rain falls.
6. **An Occluded Front**
When a cold front catches up with a warm front, the warm air between is pushed up away from the ground.



Right: A hygrometer. The difference between the readings of the 'dry bulb' (left) and the 'wet bulb' indicates the humidity of the air.



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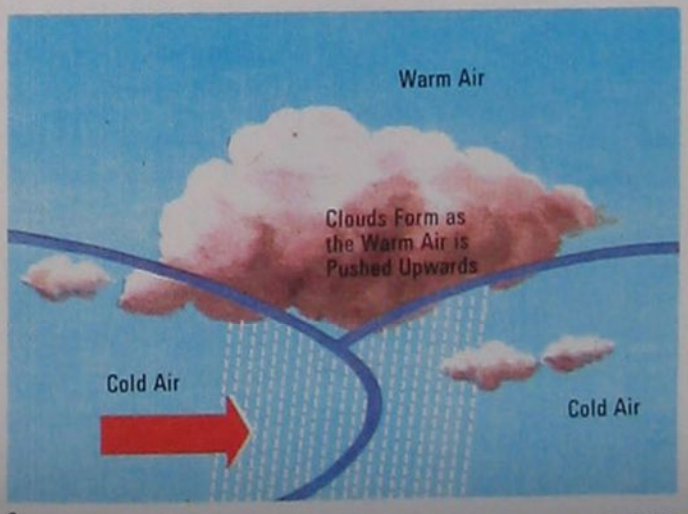

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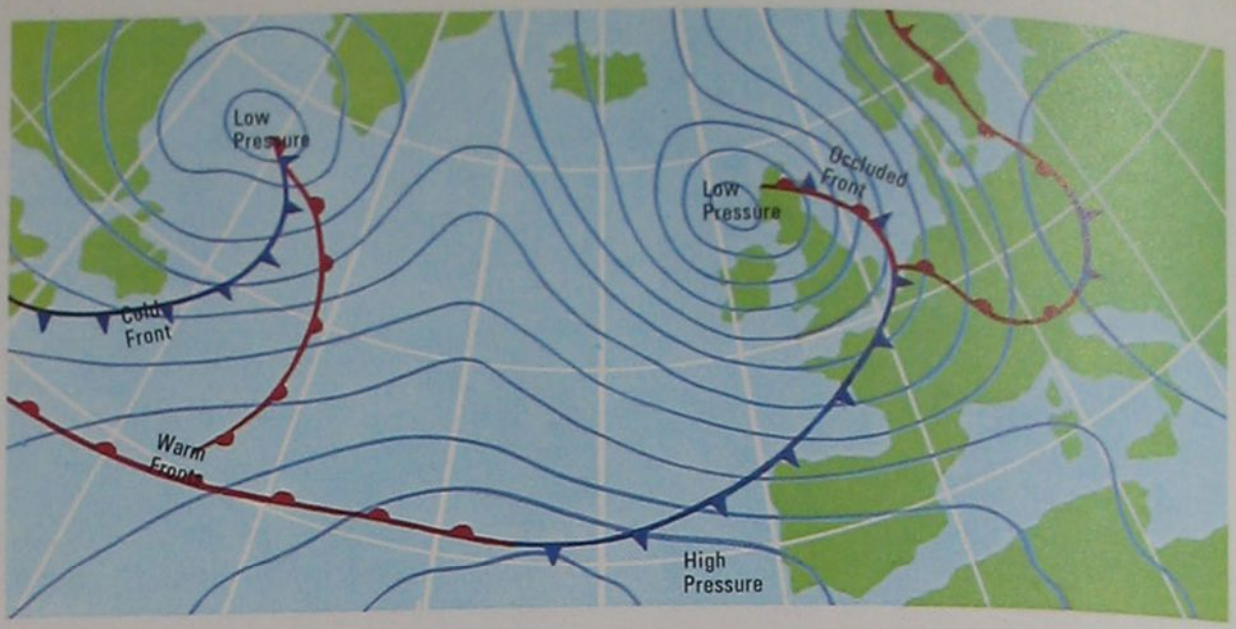


Cold, warm and occluded fronts are often present on weather maps in temperate latitudes.

Winds). As a result of all these influences, masses of air 'wander' about the Earth's surface. It is these wandering air masses that are responsible for changes in weather: they meet up with each other, they rise and fall, they are warmed and cooled, and, most important of all, they may carry rain.

In many parts of the world the weather is constant and largely predictable – the icy polar wastes, the deserts, the tropical rain forests. But in the so-called *temperate zones*, between the polar regions and the tropics, weather conditions may change greatly from day to day. Hot and cold air masses meet, forming regions of low pressure with spiralling winds called *depressions*, which may stretch for hundreds of miles. These bring long periods of unsettled weather, which is difficult to predict with any degree of certainty. The diagram shows how the weather is liable to change as a typical depression moves across the land. But a depression may 'deepen' (intensify) and produce more violent weather, or it may 'fill in' and pass almost unnoticed. It may move steadily in one direction, then veer away on a different track.

The most prominent features of weather maps in temperate regions are the lines with black semi-circles or triangles. These symbols represent *fronts*, the boundaries between two air masses of different temperatures and humidities. A *warm front* is the boundary between a mass of cold air and a following mass of warm air. A *cold front* is the reverse – the boundary between a warm air mass and a following mass of cold air. A front brings with it a change in the weather. When, for instance, a cold front passes over a particular area, the weather changes from a pattern that normally accompanies warmer air to one that accompanies colder air.

The elements of weather take many forms, sometimes beautiful and life-giving, sometimes fierce and devastating. A snow-covered landscape, a brilliant rainbow, masses of white fluffy clouds in a clear blue sky, a night sky ablaze with forked lightning – all are among the most breathtaking and spectacular sights of nature. But to those who depend on the land, sunshine and rain at the right

Talking points

* The phrase 'talking about the weather' is often used to describe boring or trivial conversation. Discuss the reasons why people talk about weather.
* Describe the life cycle of a meteorological depression. Say how it is caused and describe the effect that it has on weather conditions.
* Weather forecasting is nowadays a highly scientific process, using satellites, high altitude balloons and other modern equipment. Check the daily forecast against the actual weather over a period of two weeks. Why do you think that it is not always accurate?

Articles to read:

Atmosphere; Barometer; Hurricane; Rain.

times are the most welcome sights. In some parts of the world people may starve if crops are ruined because of lack of rain. On the other hand, too much rain can also be a killer, causing floods that destroy crops and sweep away whole villages.

Weather forecasting The weather forecaster, or *meteorologist,* is not a prophet. He does not claim to foresee the exact weather situation 24 hours ahead. He merely weighs up the probabilities of the next day's weather, using the facts known at the time. But the state of the atmosphere may change from hour to hour and from place to place, and the forecaster has to keep track of every change.

The weatherman needs to know hundreds of 'facts', and has to revise them all at frequent intervals. These 'facts', set out as a weather chart, give the forecaster a picture of the existing weather situation. He has to decide from this picture, and from the trends he can discover in it, what is likely to happen in the hours or days ahead.

Information is gathered by weather stations, some of them hundreds of miles apart. The information is sent to weather-forecasting centres, where it is plotted on a weather chart with special symbols. The chart shows the weather at the Earth's surface, but the forecaster also wants to know the conditions higher up in the atmosphere so that he can get a more complete picture of the weather.

Upper-air charts are made from information received from *radio-sondes.* These are free balloons filled with hydrogen, each of which has a radio transmitter and self-recording devices for measuring temperature and air pressure. Computers, too, play a part in modern weather forecasting. They can predict movements of weather systems quite accurately, but as yet they have not been very successfully employed in forecasting the weather accompanying these movements.

The first weather satellite, Tiros I, was sent into orbit in 1960. Since then, many more have been sent up. These satellites are able to take television pictures of cloud cover and whole weather formations, which they transmit back to weather stations on Earth. They are especially useful for giving advance warnings about hurricanes and cyclones.

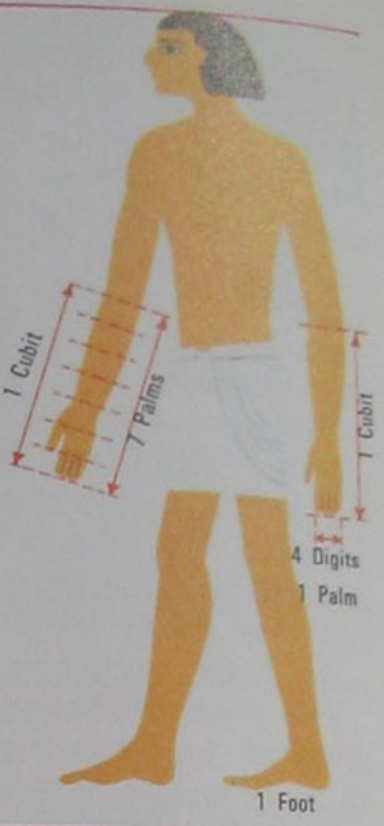
Weeds are plants that grow where they are not wanted. Weeds are a constant nuisance in gardens and on farms, where they compete with cultivated plants for air, space, and soil, water and minerals.

Weeds are well-equipped for their role. Most of them grow extremely quickly. Some can complete their entire life cycle, from germination to setting their own seeds, in a few weeks. Consequently, they can produce several generations in a single growing season, and, if left unchecked, would soon choke slower growing competitors. Typical weeds also have an efficient means of dispersing their seeds, so they are able to spread rapidly from one place to another. Not only do weeds grow well and spread rapidly, they are also generally difficult to get rid of.

Some common weeds: 1. *Groundsel;* 2. *Creeping buttercup;* 3. *Speedwell.*

Many stubborn weeds have underground stems called *rhizomes*. If, during weeding, these rhizomes are pulled out of the soil carelessly, pieces of the rhizome may be left behind, and each piece can grow into a new plant.

Weights and measures are used to find and describe the sizes of things. The two main types of measurements are those of weight and length, and from length we get also areas and volumes. Different countries use different systems of weights and measures. For instance, people in Britain and North America have measured lengths in yards, feet and inches for many years. But people in continental Europe measure lengths in metres and centimetres. This is the metric system of measurement and it is used by scientists throughout the world. The metric system is now being adopted for general use by many countries (including Britain) which previously used other systems.



Right: The Egyptians made use of the proportions on a man's body for measurement. Seven palms equalled one cubit. The British system of measurement has similar origins.

Certain trades and professions have their own systems of measurement. A farmer measures apples in bushels, a jeweller measures diamonds in carats; a chemist used to measure medicines in scruples. There are also special 'odd' measures, such as the hand (equals 4 inches) used to measure the heights of horses. The tables shown left list some of the most important weights and measures and some useful conversion factors.

IMPERIAL WEIGHTS AND MEASURES

Linear Measure
12 inches = 1 foot
3 feet = 1 yard
5½ yards = 1 pole
22 yards = 1 chain
220 yards = 1 furlong
1,760 yards = 1 mile

Square Measure
144 square inches = 1 square foot
9 square feet = 1 square yard
30¼ square yards = 1 perch
40 perches = 1 rood
4 roods = 1 acre
4,840 square yards = 1 acre
640 acres = 1 square mile

Capacity Measure
4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
8 gallons = 1 bushel
8 bushels = 1 quarter

Avoirdupois Weight
16 drams = 1 ounce
16 ounces = 1 pound
14 pounds = 1 stone
2 stones = 1 quarter
4 quarters = 1 hundredweight (cwt)
112 pounds = 1 cwt
20 cwt = 1 ton

Conversion Table for Metric and Imperial Units

to convert A to B multiply by	A	B	to convert B to A multiply by
0·394	centimetres	inches	2·539
0·061	cubic centimetres	cubic inches	16·39
0·035	grammes	ounces	28·35
2·205	kilogrammes	pounds	0·454
0·621	kilometres	miles	1·609
0·219	litres	gallons	4·546
3·281	metres	feet	0·305
247·1	square kilometres	acres	0·0047
0·984	tonnes	tons	1·016

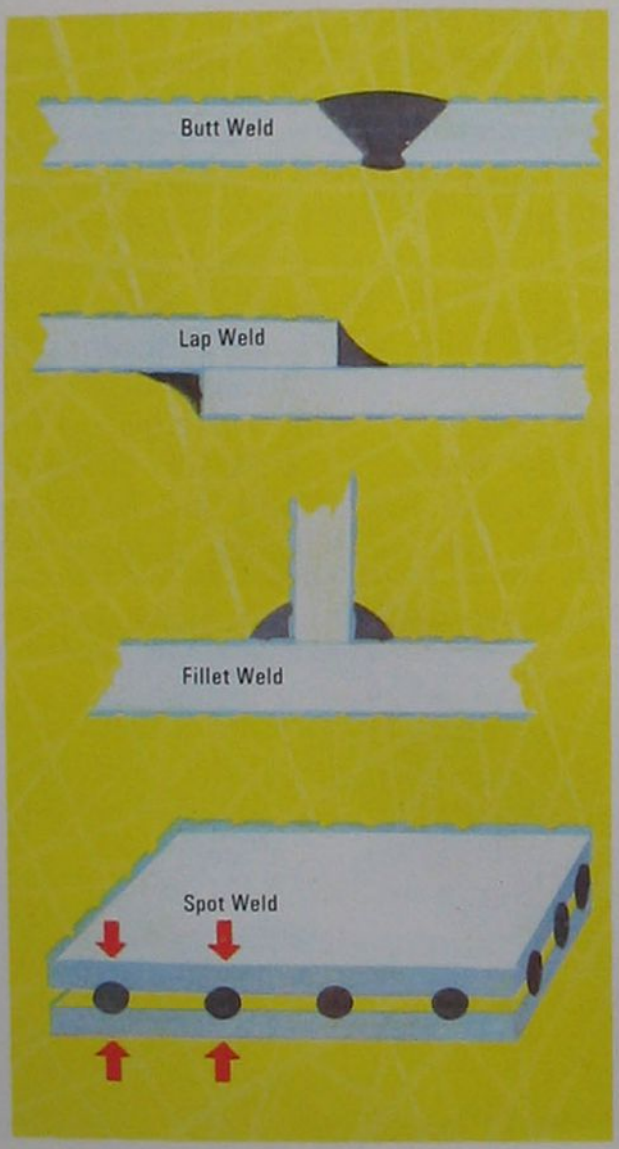
Welding is a process of joining metals together by heating. The edges of the metals to be joined are heated until they *fuse*, or melt together. They cool as one piece to form a strong joint. Welding is both quick and cheap and is widely used throughout industry.

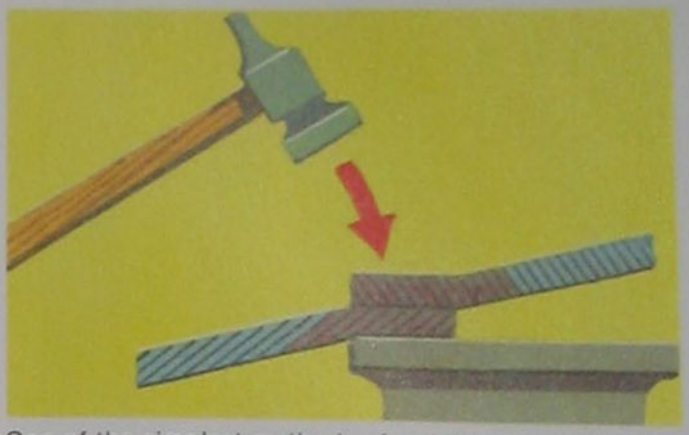
Sometimes the metal parts to be joined are pressed together as they melt to help form the joint. This is called *pressure* welding. When no pressure is applied, the process is called *fusion*

welding. A compound called a *flux* is added during welding, to clean the joint.

One simple way of pressure welding is to hammer the pieces of hot metal together. This was the method the village blacksmiths once used. *Butt welding* and *spot welding* are modern methods of pressure welding.

In butt welding, the ends of the metals to be joined are heated by a strong electric current and then pushed firmly together to form a weld. In spot welding, overlapping metal sheets are gripped between two metal rods. An electric current passing through the rods melts the metal between them. Pressing the rods together forms a welded spot. *Seam welding* is similar but makes a continuous weld.





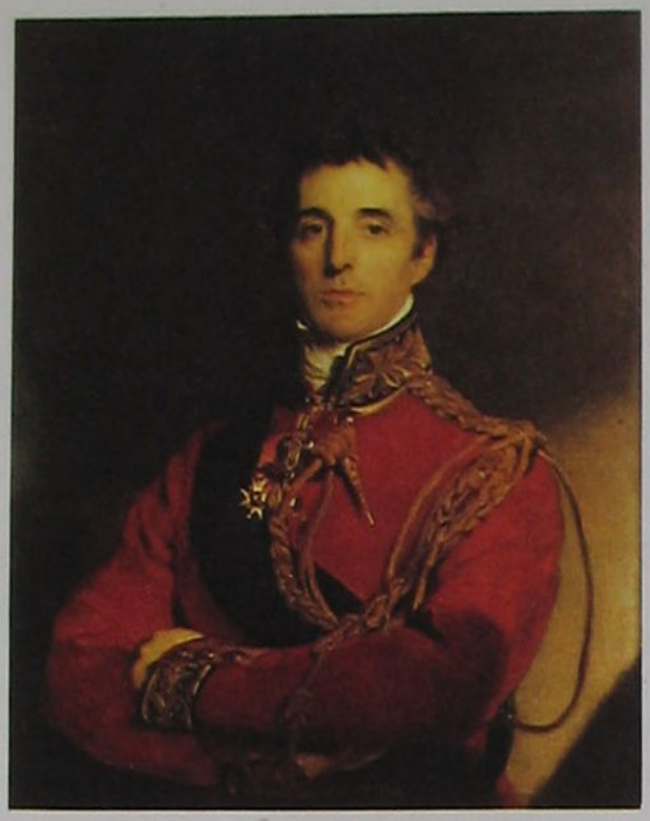
One of the simplest methods of welding is to hammer together pieces of red-hot metal.

In fusion welding, extra metal is often added to the joint from a *filler rod*, which is melted at the same time as the other metals. Electricity or gas may be used to melt the metals. In *electric-arc welding*, the metal is melted when an electric current arcs (jumps) from a rod to the joint. In *gas welding*, a very hot gas flame from a welding torch melts the metal. The most common torch is the oxyacetylene torch.

Wellington, Duke of (1769-1852), was a British soldier and prime minister. He drove Napoleon's armies out of Spain and Portugal and defeated Napoleon at the Battle of Waterloo. He became known as 'the Iron Duke' because of his stern and inflexible character.

Wellington was born in Dublin and educated at Eton College and a military college in France. He joined the army at 18 and served in Ireland, the Netherlands and India. In 1806 Wellington became a member of parliament. Two years later he was sent to Spain with a British divison to help the Spanish and Portuguese against France. Wellington defeated the French who were forced to leave Portugal. Later he commanded the British forces who drove the French out of Spain.

Wellington was made a viscount in 1809. He was given the title of Duke of Wellington for his victory at the Battle of Toulouse shortly before Napoleon gave up the French throne in 1814. After



A portrait of Arthur Wellesley, 1st Duke of Wellington, by Sir Thomas Lawrence. Wellington was an austere and high-principled soldier who inspired his troops with confidence but not with affection.

Napoleon's return to power Wellington commanded the armies of several countries that finally defeated Napoleon at the Battle of Waterloo in 1815. He was prime minister from 1828 to 1830, and served in later governments before retiring in 1846. As a politician, he was not always popular, but he was regarded as a national hero.

Wellington province lies at the southern end of New Zealand's North Island. It occupies an area of 10,870 square miles. Mountain ranges and hill country cover the central and northern portions of the province. There are several volcanic peaks in Tongariro National Park. Near the western and southern coasts are fertile valleys, such as the Wairarapa and Manawatu districts, where farmers rear sheep and dairy cattle, and cultivate apple and cherry orchards.

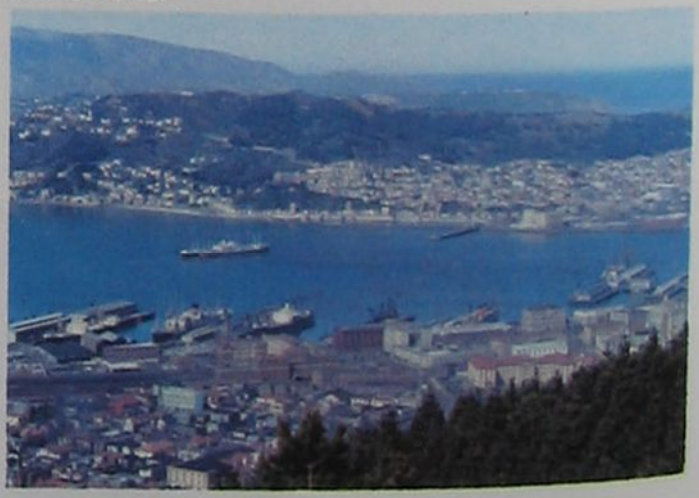
At the extreme southern tip of the province is the national capital, Wellington. Almost a third of the province's 484,600 people live there. Lower Hutt, the second largest city in the province, is another manufacturing centre located in the Hutt Valley district. Palmerston North is a market and processing town for dairy and livestock products.

Captain James Cook first sighted Wellington Harbour in 1773. The New Zealand Company sent the first settlers to Wellington from Britain in 1840.

Wellington is a seaport and the capital city of New Zealand. It is situated at the southern tip of the North Island and faces Port Nicholson, one of the finest natural harbours in the world. It is the seat of government of New Zealand, the Parliament Building being a large building of local stone. The urban area has a population of 328,800. Geographically close to the centre of New Zealand, the city plays an important part in the country's trade and communications, the port handling considerable export and import traffic. A cable car runs up from the city centre to a 500-ft viewpoint.

Wellington has a mild and temperate maritime climate. Average January tem-

The harbour at Wellington covers a total of about 32 square miles. It is one of the finest natural harbours in the world.



Much of the central business area of Wellington has been built on land that has been recovered from the harbour by land reclamation projects. Most of the inhabitants of the city live on the slopes of the surrounding hills that tower as much as 1,000 feet above the harbour.

perature is around 60°F, and July averages about 50°F. About 47 inches of rain falls every year.

Wells and springs When rain falls, some water flows on the surface directly into streams, some evaporates, and some seeps into the ground. The rocks underground become *saturated*, full of water. The highest level of saturation is called the *water table*. In wet weather, the water table rises closer to the surface. To obtain underground water, people drill wells down to the water table.

Some *porous* rocks, called *aquifers*, allow water to seep through. But other rocks block the passage of water. Sometimes an aquifer is enclosed by layers of material that seal the water in. Where such aquifers reach the surface in hills, the rainwater seeps into them and piles up under pressure. When a well is sunk on a nearby plain, the pressure forces the water upwards. Such wells are called *artesian wells*, and occur in the London and Paris basins and parts of Australia.

Springs appear around the base of water-bearing rocks which have under them a layer of rock through which water cannot seep. In regions where volcanoes are common, springs are often hot, sometimes giving off steam. The water may contain chemicals with medicinal properties.

Geysers are a special type of hot springs. The water in geysers erupts from time to time in tall columns of hot steam. Geysers occur in Iceland, New Zealand and the United States.

Wentworth, William Charles (1790-1872), was an Australian patriot who campaigned for colonial self-government. He was born on Norfolk Island. Later, he studied law at Cambridge University. After returning to Sydney, he became a lawyer and took over a newspaper called the *Australian*, which he used to publicize his views. He also helped to found the Australian Patriotic Association whose aim was to win representative government from Britain.

John Wesley travelled through England preaching his simplified faith in the open air.

In 1842, Britain permitted some of the New South Wales Legislative Council to be elected. Wentworth served as an active member. When Britain offered the colonies full self-government in 1850, Wentworth chaired the committee to draft New South Wales's constitution. Britain approved the constitution in 1854. Wentworth was later chosen to serve as president of the legislative council.

Wesley is the family name of two preachers who began a religious revival in England. They were the sons of a Lincolnshire rector.

John Wesley (1703-1791) was the founder of the Wesleyan Methodist Church. While a minister in the Church of England, he became convinced that salvation comes only through faith in Christ. He was barred from the established Church, so he took his message to the masses,

preaching in the open air and travelling a quarter of a million miles, mostly on horseback.

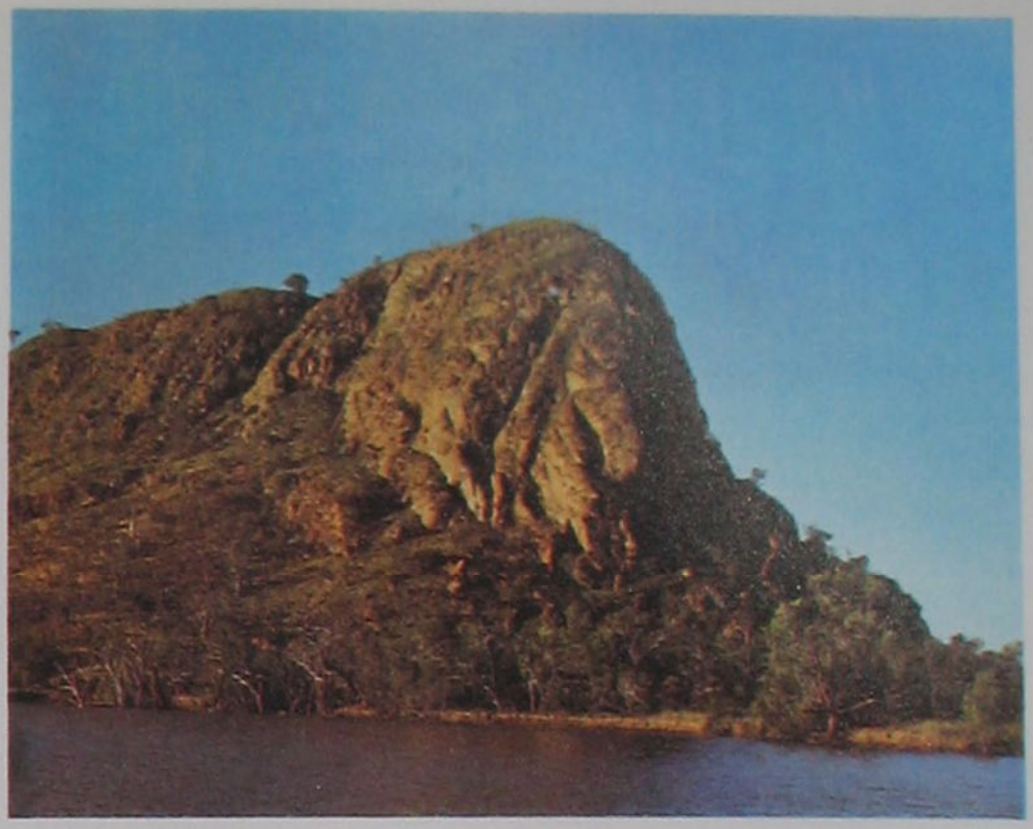
Charles Wesley (1707-1788) helped his brother in his work and wrote more than 6,000 hymns for the newly formed Church.

West, The, refers to the western frontier of the United States, the vast area of prairies, mountains, deserts and canyons stretching from the Mississippi River to the Pacific Ocean. But more than a geographical area, it refers to a colourful period in American history and a way of life which, through its legends, stories, songs and films, has captured the imagination of people all over the world.

The period of the West started during the 1840's, when the first settlers began moving westwards over famous trails such as the Santa Fe, Chisholm, and Oregon trails. It ended about 1890, when a more-or-less permanent population had been established in the area. At first, the settlers came in trains of covered wagons, banding together for companionship and defence against the Indians. The wagon held the family and all its household possessions, together with food, water and other supplies for the journey. After the opening of the trans-continental railway in 1896, people and goods moved westwards at a much faster rate.

Of all the lures of the West, gold and silver were perhaps the most attractive. The early rush of 'Forty-Niners' (so-called because gold was discovered in 1849) to California was followed by later rushes to Colorado, Nevada, Idaho, Montana and South Dakota. Prospectors flocking to these areas created new towns overnight. Some people did grow rich, but others were ruined by the outrageous prices charged for food and supplies. By the end of the century the mines were worked out. Previously thriving communities changed into 'ghost towns'.

Carrying the U.S. Mail across the Prairies in the 1860's. The early days of the West were fraught with danger from the Indians who lived there.



Elephant Rock on the Ord River in Western Australia. Together with its tributaries, the Ord drains an area of about 17,000 square miles.

Another attraction of the West was new land to farm or rear cattle on. Many people took advantage of the government's offer of free or cheap land, through the Homestead Act of 1862 and similar schemes. Sometimes violent conflicts occurred between the ranchers, who needed open ranges for their grazing herds, and the farmers who were fencing off more and more land for cultivation.

Cowboys faced long, lonely days driving the herds to 'cow towns' for shipment east. On occasions they would risk their lives trying to control stampeding animals.

Rustlers sometimes stole cattle and changed their identifying brands. In the mining towns, prospectors lost their claims through trickery and cheating, and throughout the West gangs of outlaws, such as the Dalton Boys and Frank and Jesse James, roamed the countryside, robbing and killing.

Western Australia is the country's largest state. It covers 975,920 square miles, nearly one-third of Australia's total area. To the east of the state lie the Northern Territory and South Australia. The sea surrounds it on the other sides. To the north is the Timor Sea, to the west the Indian Ocean, and to the south the Great Australian Bight.

Western Australia has a population of 1,001,300 which, for its land area, is very small. Most people live in the south-western part of the state in and near Perth, the state capital, and Fremantle, the leading port. Smaller towns in the state are mining and shipping centres.

Except for narrow coastal plains, notably the Swan River area around Perth, almost all the state consists of a plateau. In three regions, the plateau becomes mountainous. The Kimberley Mountains

This map shows the location of Western Australia.

in the north-east are rugged and divided by deep gorges. The Hamersley Range in the north-west contains the state's highest point, Mt. Bruce (4,024 ft.). Most of Western Australia's rivers flow through these higher regions.

The climate varies greatly throughout the state. In the north, the weather is hot and tropical. The north-east receives monsoon rains during the summer. The south-west, on the other hand, has a Mediterranean-type climate, with rain in winter. Elsewhere, rainfall is meagre. The central and eastern parts of the state are almost all desert.

Herding and farming are major occupations in Western Australia, and the state exports large quantities of wheat, flour, Merino wool and beef. The most fertile area is the south-west, where herds of dairy cows are raised along the coast. Orchards and vineyards also flourish. Farther inland, as rainfall decreases, the fruit-growing regions give way to wheat fields, and cattle and sheep stations. Grasslands in the Kimberley Mountain region support beef cattle.

Western Australia mines about two-thirds of the nation's gold. The richest fields lie in the southern interior. Recent finds of iron ore in this area are being exploited, and asbestos and coal are also found in the state. The state's growing industries include metal processing (iron, steel, aluminium, and others), oil refining, and the manufacture of chemicals, textiles, and paper. Perth and Kwinana are the main industrial centres.

The Dutch and French visited the coast of Western Australia in the 1500's and 1600's. The British came later, establishing an army post near Albany in 1862. Captain Charles Fremantle took possession of the colony for Britain in 1829.

Strikes of gold, first in the Kimberley Mountains (1885) and later at Kalgoorlie and Coolgardie (1892), led to a rush of new immigrants. In 1901, Western Australia joined in the formation of the Commonwealth of Australia.

West Indies These are a chain of islands that lie between the Caribbean Sea and the Atlantic Ocean. There are three main groups, the Bahamas, the Greater Antilles, and the Lesser Antilles. The people are of mainly Negro origin.

The Bahamas, the most northerly of the West Indies, are a chain of coral islands. The people grow tomatoes and vegetables. Visitors flock to the islands because of their beautiful scenery and pleasant, sunny climate.

There are four large islands in the Greater Antilles. Cuba, the largest and most westerly, is partly a plain, with mountains in the west and east. It has rich, fertile soil which grows sugar-cane, tobacco, fruit and vegetables. People mine iron ore. Cuba is a republic, which has close ties with the communist world.

Hispaniola, east of Cuba, consists of the republics of Haiti and the Dominican Republic. It has a number of mountain areas. Some areas are fertile, but farming is not highly developed.

Jamaica, south of Cuba, has central mountains and fertile coastal plains. Farmers grow sugar-cane, coffee, pimento, and allspice. Rum is an important product. There are rich deposits of bauxite (aluminium ore).

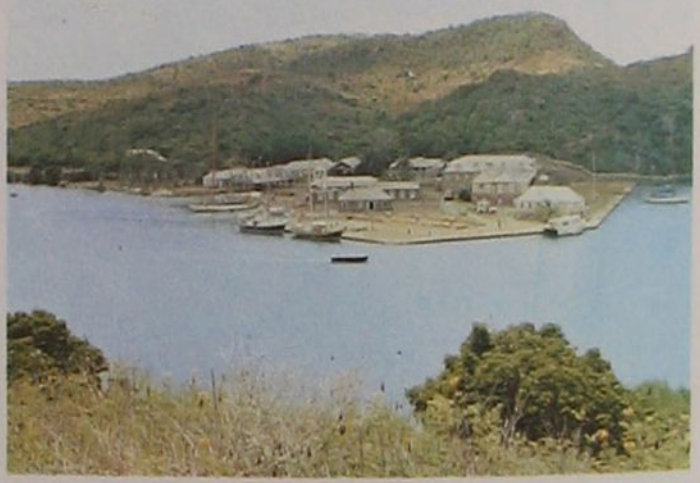
Puerto Rico, the fourth of the Greater Antilles, is a republic closely associated with the United States. It has the richest land of the four large islands, and produces sugar-cane, coffee, tobacco, and fruit. It has many factories.

In the Lesser Antilles, two groups of islands run south-west towards South America. They are the Leeward Islands and the Windward Islands. Most of them were British or French possessions, and many have now attained a large measure of independence. An active volcano, Mount Pelée, on Martinique erupted in 1902, killing thousands of people.

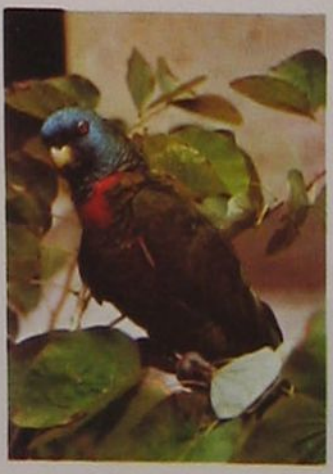
Opposite: An elaborate Carnival dress. Carnivals are very popular in all the islands of the West Indies.

COUNTRIES AND TERRITORIES OF THE WEST INDIES

Country	Area in sq. mi.	Population	Capital	Status
Antigua	170	65,000	St. John's	Brit. associate
Anguilla	35	6,000	Basseterre	Brit. colony
Bahamas	4,400	169,000	Nassau	Brit. colony
Barbados	166	254,000	Bridgetown	Monarchy
Cayman Islands	100	10,000	George Town	Brit. colony
Cuba	44,218	8,553,000	Havana	Republic
Dominica	290	74,000	Roseau	Brit. associate
Dominican Republic	18,704	4,012,000	Santo Domingo	Republic
Grenada	133	105,000	St. George's	Brit. associate
Guadeloupe	687	323,000	Basse-Terre	French dept.
Haiti	10,714	4,768,000	Port-au-Prince	Republic
Jamaica	4,411	1,861,000	Kingston	Monarchy
Martinique	425	332,000	Fort-de-France	French dept.
Montserrat	39	12,000	Plymouth	Brit.colony
Netherlands Antilles	371	224,000	Willemstad	Monarchy
Puerto Rico	3,435	2,712,000	San Juan	U.S. commonwealth
St. Kitts-Nevis		45,000		
St. Lucia	238	108,000	Castries	Brit. associate
St. Vincent	150	92,000	Kingstown	Brit. associate
Trinidad and Tobago	1,980	1,010,000	Port-of-Spain	Monarchy
Turks and Caicos Is.	166	10,000	Grand Turk	Brit. colony
Virgin Is. (Brit.)	59	10,000	Road Town	Brit. colony
Virgin Is. (U.S.)	132	62,000	Charlotte Amalie	U.S. territory



Above: Coconut palms are a common feature of the islands of the West Indies. Above right: A scene on Antigua, one of the islands of the Lesser Antilles. Right: The West Indies are the home of a large variety of brightly coloured birds.



The islands produce many crops, including sugar, coffee and fruit. Dominica produces most of the world's limes.

Along the coast of South America runs a chain of small islands. Their crops are similar to those of the other Lesser Antilles. Trinidad, the largest, and an independent country, produces most of the world's asphalt for making roads.

Christopher Columbus reached the West Indies in 1492. He called them

Mountainous scenery in New Zealand's Westland. This province on the west coast of South Island has a high annual rainfall, but the rain usually falls in short but very heavy showers, so it also has a high average of sunny hours.

Indies because he thought he was near India. Spaniards colonized them in the 1500's, and the British, French and Dutch set up colonies in the 1600's. The islands were the haunt of buccaneers and pirates in the 1600's and 1700's. The European colonists enslaved the natives to work on the plantations, but many of them died under the harsh treatment. Today, only a few hundred of the original Carib Indians survive. Many Negro slaves were imported from Africa. They now make up the bulk of the population of the West Indies. Most of the islands now have complete or partial independence, although some prefer to keep close ties with Britain and are classed as Associated States.

Westland is both a land district and a province of New Zealand. The land district includes the province and part of Nelson province as well. Westland district occupies a 6,010-square-mile area of the South Island's west coast. The land rises from a bush-covered coastal region to the Southern Alps.

Many of Westland's 24,800 inhabitants work in state-owned mines in the Grey and Buller coalfields. Others are fishermen or lumberjacks. Still others work in factories in Greymouth, Westport, Hokitika, and Reefton. Westland National Park and other resort areas offer facilities for the many tourists who visit the district each year.

Many explorers arrived in Westland during the 1800's. The discovery of gold in the Buller River in 1859 was the first of a number of spectacular strikes that brought many prospectors into the district during the 1860's and 1870's. During that era, Westland earned a reputation as a rough and lawless place.

West Lothian (area 120 square miles) is one of the smallest counties in Scotland, extending a mere 13 miles from north to south. Its county town is Linlithgow, and its population is 108,500.

West Lothian is situated in the Central Lowlands, and is bordered on the north by the Firth of Forth. The Bathgate Hills rise to more than 1,000 ft. in the south. The county is drained by the Almond and its tributary, the Avon. Much of the land is fertile and heavily cultivated. Barley

and oats are the chief crops. There are also some dairy farms, and pigs and poultry are reared. Some coal is mined.

Westmorland (area 788 square miles), a beautiful county of north-western England, lies partly in the Lake District. Its county town is Appleby, and its population is 72,700.

Apart from a short, sandy coastline along Morecambe Bay, most of the county is mountainous, with high moorlands, steep-sided valleys and magnificent lakes. Many famous peaks rise on the border with Cumberland, including Helvellyn (3,118 ft.) and Bowfell (2,960 ft.). Lake Windermere, Grasmere, Hawes Water and Rydal Water lie within the county. Westmorland is drained by the rivers Eden, Lune and Kent.

Tourism is the main industry. Kendal, the largest town, is a focal point for visitors. Sheep are reared on the fells, and dairy cattle in the valleys. There are some granite quarries.

West Virginia lies in the east-central part of the United States and covers an area of 24,181 square miles. Forested mountains cover much of the state. The Ohio River flows along its western border. Of the state's 1,744,000 inhabitants about six out of every ten live in rural areas. Much of the state is made up of the rugged Appalachian plateau where the rocky land is too barren to support farming.

This map shows the location of West Virginia.

Huntington and Charleston, the capital, are the chief industrial centres.

West Virginia produces coal, natural gas, oil, salt and stone. The state manufactures chemicals, iron and steel, glass, pottery and textiles.

Until the Civil War, West Virginia was part of neighbouring Virginia. In 1861, Virginia joined the Confederacy and West Virginians voted to remain loyal to the Union. They gained statehood in 1863.

Whales are sea mammals that live entirely in the water and never come on to dry land. In many ways they look like big fish, but they have many features that only mammals have. (See Mammals.) They are warm-blooded. Female whales give birth to live young and feed them on their own milk. Whales are covered with skin, not scales, and they breathe air. But whales have no hind legs and have flippers instead of front legs. They use these to guide themselves when swimming. They propel themselves along by great movements of their two-finned tails. Most whales can dive to great depths, holding their breath for long periods. When they surface, they breathe out and their breath forms a cloudy 'spout'—like a person breathing on a very cold day.

There are two main kinds of whales. Toothed whales have true teeth, and feed on all kinds of fish, as well as squids, octopuses, and even other whales. They include the small dolphins and porpoises; the killer whale; and the sperm whale, which gives valuable spermaceti, ambergris, and sperm oil.

The second group—whalebone, or baleen, whales—have no teeth. Instead they have plates of horny baleen, or whalebone, hanging from the roof of the mouth. This filters the tiny plants and animals of the plankton from water passing through the whale's mouth (see Plankton). These form the baleen whales' only food, yet these whales include the biggest creature ever to have lived on earth—the

blue whale. It may reach 100 feet in length and 150 tons in weight.

Whales have a layer of blubber (fibrous material containing oil) under their skin. For hundreds of years, men have hunted whales for this oil. At one time, they were caught with hand harpoons by men in rowing boats called whalers. The whale pulled the boat along, sometimes for hours, until it tired. Then the men killed it and returned with it to their mother whaling ship. Today, fast whaling ships hunt whales using harpoon guns and explosive harpoons.

Today, about 150,000 whales are killed every year, mostly in the Antarctic. In spite of treaties limiting the number of whales that may be caught, their numbers are decreasing rapidly. The blue whale and three others are among the animals that conservationists believe are in danger of becoming extinct.

Wheat is a very important crop, used to make flour for bread and other products. Hundreds of millions of people eat wheat in this way throughout the world, and wheat is grown on a larger part of the Earth's surface than any other single crop.

Wheat is a cereal crop, like rice and maize. Cereal crops are in fact grasses, and we eat the seeds or grains of these crops. The wheat grain is nearly always first ground into flour.

Wheat grows best in temperate regions of the world. At harvest time, the fields of golden wheat, rippling in the wind, are a beautiful sight. The world's leading wheat-growing countries are Russia and the United States. Canada, France and India rank next in importance.

Farmers do not grow wheat on the same land every year. They alternate wheat with other crops such as clover and potatoes. Rotation of crops in this way helps to keep the soil fertile. Wheat seed is planted in the autumn or spring, and young green shoots soon appear, looking like blades of grass. The plants grow to a height of 2 to 5 feet, topped by heads

Varieties of wheat produced by artificial mutation. Both natural and artificially produced varieties of a plant are used for breeding.

containing the kernels or grain. Once the wheat is ripe, it must be harvested immediately, otherwise bad weather might ruin the crop. Harvesting is often done by machines called combine harvesters, which cut and clean the wheat, and thresh it to remove the grain.

Wheat grain is ground into flour, most of which goes into making bread. Other wheat products include *pasta*, such as spaghetti and macaroni, and breakfast foods. The outer parts of the kernels are used to make bran for livestock feed.

Whitney, Eli (1765-1825), was an American inventor and a pioneer of mass-production. He helped to bring his country into the 'Industrial Age'. Whitney's genius for mechanical things showed itself at an early age. At 12 he made a violin, and while still a teenager he ran his own business, making wrought nails.

Whitney was at first a teacher. After five years, he entered Yale College and gained his degree at the age of 27. He then went to Georgia and studied law. There he saw how cotton was produced, and learnt of the need for a machine that could separate the cotton seeds from the fluffy bolls. In less than two weeks he designed and built such a machine. He called it the *cotton gin*. It could do the job 50 times faster than a man, and it revolutionized the cotton industry in the United States. Whitney patented his machine in 1794. He formed a company to produce it. But the demand was so great that others stole his design and made cotton gins too.

Whitney next became a gun-maker. He built machines that could turn out thousands of identical, interchangeable gun parts. Using these, inexperienced workers could assemble guns quickly and easily. Previously, guns had all been made by hand, one at a time. For this some credit him with being the 'father of mass production.'

Wight, Isle of, lies off the south coast of England. It is separated from Hampshire on the mainland by a stretch of water known as the Solent. It has an area of 147 square miles and a population of nearly 110,000. The island's two main sources of income are mixed farming, especially dairy cattle, and tourism, as the island enjoys a mild climate. Ryde, Cowes, Ventnor and Shanklin are important tourist resorts. Newport is the main town, and Cowes is the main port, and is famous for the sailing boat races held there.

Wigtownshire (area 487 square miles), a county in the extreme south-west of Scotland, forms part of the district of Galloway. The Northern Irish coast lies only 21 miles away, across the North Channel. Its county town is Wigtown

(administrative centre Stranraer), and its population is 27,300.

Wigtownshire is divided into a double peninsula, the Rhins and the Machars, and a wild upland region in the north and east called the Moors. Dairy farming is the main industry. Barley, oats and turnips are also grown, and there are some sheep farms. Stranraer is the largest town and the port for the crossing to Ireland.

Wilberforce is the name of two influential Englishmen, father and son, one a reformer and the other a clergyman.

William Wilberforce (1759-1833), was a statesman who devoted his life to the *abolition* (putting an end to) of the slave trade and slavery in the British colonies. Born in Hull, he studied at Cambridge University and became a Member of Parliament at 21. He soon gained the confidence and friendship of William Pitt the Younger, who became prime minister in 1783. Wilberforce joined forces with Thomas Clarkson, and began publicly attacking the slave trade in 1787. In 1807 he had the satisfaction of seeing his anti-slave-trade bill become law.

He then turned his attention to slavery itself. He retired from Parliament in 1825, but continued his efforts to have all slaves freed. A few days after his death slavery was abolished throughout the British Empire.

His son, *Samuel Wilberforce* (1805-1873), was Bishop of Oxford and later Bishop of Winchester. An eloquent and persuasive preacher, he was a key defender of traditional Church of England teachings at a time of division and crisis in the Anglican ranks.

Wild flowers grow naturally throughout the countryside. Unlike the flowers in our gardens, they have not been specially planted or cultivated. Wild flowers can be found almost anywhere—along the roadside, in a rubbish heap, in a marsh or bog

Wild flowers grow in all parts of the world, varying with climate and soil. The ransom, loosestrife and bluebells here are flowers of early summer.

or on a rocky hillside. Some of them are natives of the region they grow in. Others are flowers that have been transplanted from another part of the world, and that now grow wild.

Wild flowers include many lovely species of plants. Collecting them is an interesting hobby. The collected flowers can be preserved by allowing them to dry and pressing them between the pages of a heavy book. Some of them will fade as they dry, but others will keep their colour. The pressed flowers can be mounted in a scrapbook. You should label them with their common names, their scientific names, and where they were found.

Many of the best known wild flowers grow in woodlands or in meadows. Some woodland plants bloom early in the year, before the leaves come on the trees. Lilies of the valley, snowdrops, and wild roses are among familiar woodland flowers. The wild flowers of meadows and fields include buttercups, clover, and cowslips.

As well as the familiar wild flowers, others grow in deserts, on high mountains, and along the seashore.

William is the name of four kings of England.

William I (about 1027-1087), called *William the Conqueror*, was the first Norman king of England. He was born at Falaise, in France, and became Duke of Normandy in 1035. He spent his early years defending the duchy from greedy neighbours.

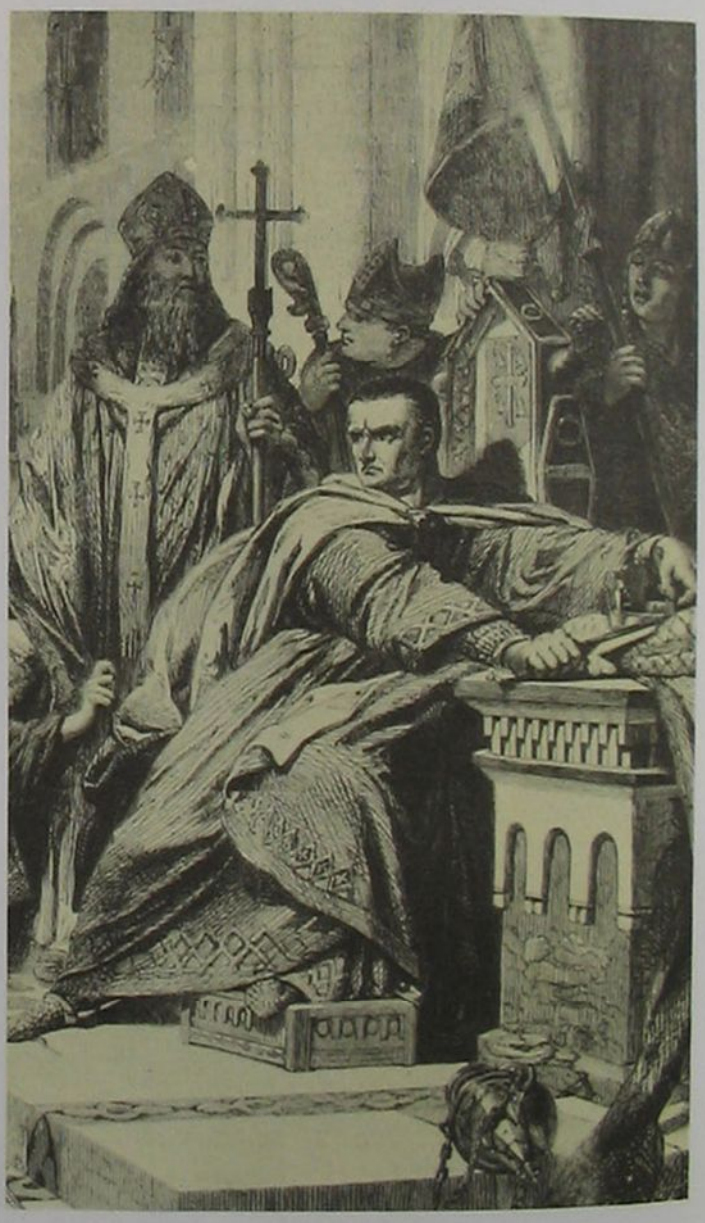
William was a cousin of King Edward the Confessor of England. In 1051, Edward recognized him as heir to the English throne. One of William's rivals was Edward's brother-in-law Harold. In 1064, Harold was shipwrecked on the Normandy coast and imprisoned. In order to obtain his freedom, Harold promised to uphold William's claim to the throne.

In 1066, on Edward's death, Harold broke his promise. He took the English throne himself, after being elected by the nobles. William immediately invaded England. He crushed Harold's Anglo-Saxon armies at the Battle of Hastings, and Harold was killed in the fighting. William had himself crowned on Christmas Day, 1066.

It took William another five years to subdue England completely. His lasting memorial is the *Domesday Book*. This was a record, ordered by him, of a survey of England, listing property values, owners and populations throughout the kingdom.

William II (about 1056-1100), son of William the Conqueror, became King of England on the death of his father in 1087. He was called *Rufus* (the Red) because of his ruddy complexion.

The coronation of William the Conqueror, Duke of Normandy, as King of England in 1066.



Unlike his pious and temperate father, William was coarse and violent, and could neither read nor write. His favourite pastimes were fighting and hunting. During his reign he waged war at different times with the Welsh, the Scots and the King of France. His anti-religious views and his villainous reputation provoked a bitter quarrel with the Church.

William was killed by an arrow in what was claimed to be a hunting accident in the New Forest.

William III (1650-1702), ruled jointly with his wife, Mary II, over Great Britain and Ireland. William was the son of William, Prince of Orange, and the grandson of Charles I. He married his cousin Mary, a daughter of James II, in 1677. As a young man, he was appointed captain-general of the Dutch forces and directed the Dutch war against Louis XIV.

In 1688, a group of English nobles, alarmed at King James II's Catholic policies, invited William to take the throne of England. He landed at the head of a small army, and James fled. William and Mary were crowned in 1689. In 1690, William routed James II at the Battle of the Boyne in Ireland. Many people in Britain felt that William was merely using his new kingdom's resources to bolster the Dutch war against France.

William IV (1765-1837), the third son of George III, became King of Great Britain and Ireland on the death of his brother George IV, in 1830, at the age of 64.

William chose a career in the navy, in which he rose to the rank of lord high admiral. He was a simple, genial man, who disliked pomp. The public affectionately called him 'Sailor Bill'. He was completely unprepared to be king and had no head for politics. This led to his other nickname of 'Silly Billy'.

During the Whig government's Reform Bill crisis of 1830-1832, when the country faced civil war, William showed his good sense by agreeing to create new peers. This saved the day because it provided a majority for Reform in the House of Lords.

William IV, third son of George III, was affectionately known as 'Sailor Bill' because of his years in the navy.

Wiltshire (area 1,344 square miles) is an inland county of southern England. Its county town is Salisbury (with the administrative centre at Trowbridge), and its population is 486,000.

Most of the land consists of chalk uplands, including Salisbury Plain and the Marlborough Downs. There are clay plains in the north-west of the county. In the east, Savernake Forest is renowned for its beech trees. The main rivers are the Kennet, the Bristol Avon and the Salisbury Avon. Much of Wiltshire is under pasture, supporting dairy cattle and sheep. Wheat, barley and root crops are widely cultivated.

Swindon is the largest town; Salisbury is famed for its magnificent Early English cathedral; beer and tobacco are produced at the market town of Devizes; carpets come from Wilton and Bradford-on-Avon,

and from Trowbridge which has engineering industries. Wiltshire has been settled from very early times and its prehistoric remains include Avebury Circle, Stonehenge, and the artificial mound at Silbury Hill.

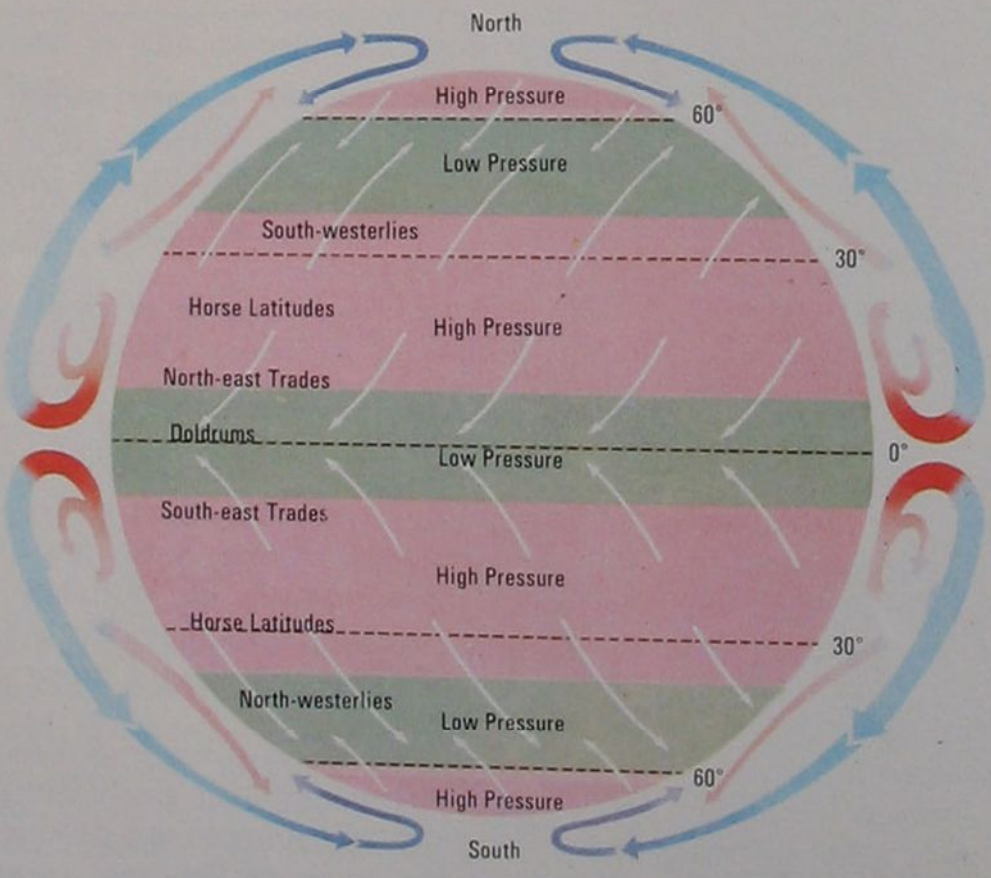
Wind is the movement of air over the Earth's surface. Winds develop for a number of reasons, the most important being the unequal heating of the surface of the Earth. More of the Sun's heat is received at the Equator than at the Poles (see Climate). At the Equator, heated air rises. At the Poles, cold, dense air sinks. For this reason, near the Earth's surface the pressure is greater at the Poles than at the Equator, while the reverse is true in the upper air. As a result, there is a general flow of equatorial air towards the Poles in the upper air, and polar air towards the Equator near the surface.

The rotation of the Earth (from west to east) affects the winds by deflecting them—to the right in the northern hemisphere, to the left in the southern.

The pattern of winds is further complicated by the fact that the Earth's surface is composed of land and water. Water heats up less quickly than land but

Sir George Simpson's Version of the Beaufort Wind Scale

	Description	*Effects that can be observed*
1	Light Air	Wind direction shown by drift of smoke
2	Slight Breeze	Wind felt on face; leaves rustle; flags stir
3	Gentle Breeze	Leaves and twigs in constant motion; wind extends light flags
4	Moderate Breeze	Dust and small branches move; flags flap
5	Fresh Breeze	Small trees with leaves begin to sway; flags ripple
6	Strong Breeze	Large branches move; flags beat
7	Moderate Gale	Whole trees move; flags extended
8	Fresh Gale	Twigs break off trees; walking is hindered
9	Strong Gale	Slight damage to houses (such as slates removed)
10	Whole Gale	Trees uprooted; much damage to houses
11	Storm	Widespread damage
12	Hurricane	Excessive damage

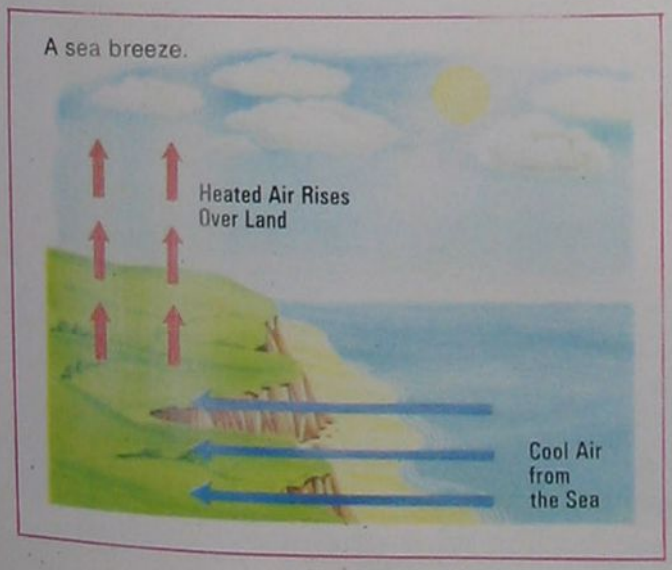


Left: Wind and pressure belts throughout the world. The prevailing wind directions are shown by arrows.

Windmills in the Netherlands, where they play a very important part in draining the country.

keeps its warmth longer. The result of this can sometimes be noticed on a calm, hot summer's day at the seaside. During the day, the air above the land is rapidly heated and rises, while a current of cooler air moves in from over the sea to take its place. The draught of cooler air is known as a *sea breeze*. At night, the air stream is reversed, for the land cools down faster than the sea.

On a far greater scale, the same process produces *monsoons*, where winds blow from the sea to the land throughout the summer, and from the land to the sea throughout the winter. South-East Asia has monsoon winds.



Certain winds blow with predictable regularity. The *trade winds* blow from the belts of high pressure around latitudes 30° north and south (called the *horse latitudes* at sea) to the equatorial low-pressure region called the *doldrums*. They blow from the north-east in the northern hemisphere and the south-east in the southern hemisphere. Beyond the horse latitudes in both hemispheres is a belt of winds known as the *prevailing westerlies*. They are not as constant as the trade winds, particularly in the northern hemisphere, where local centres of low pressure *(depressions)* frequently upset the wind pattern. In the southern hemisphere the prevailing westerlies blow from the north-west and are known as the *roaring forties*.

Windmill Windmills are one of Man's oldest and cheapest ways of producing power. A windmill has blades or sails which turn as the wind blows through

them. The turning force provides power for a saw wheel, grinding stone, water pump or similar machine. Windmills were once very common. Then steam power replaced them for many jobs. But they are coming back into use today for small jobs because they are one of the cleanest ways of producing energy. Windmills are widely used in Germany, Denmark and the Netherlands.

Windmills were probably invented in Asia. Early ones had cloth sails, like those of a sailing boat. The sails could be furled in a high wind. Windmills came into use in Europe in the 1100's. Most were made of wood. In some, the entire mill, including the machinery and workrooms, had to be turned to make the blades face into the wind. But in most mills, the part to which the blades are attached can be turned independently. Vanes, called *fantails* keep the blades headed into the wind.

Windmills constructed of steel and mounted on a tower of metal girders were first built in the United States in the 1880's. This type is still used in many places to pump water for irrigation.

Winnipeg, the capital of the province of Manitoba, is one of western Canada's most important cities. It is sometimes called the 'Gateway to the West' because goods from the industrial cities of the east pass through its railway yards. It is also an important marketing and processing centre for the products of the Canadian prairies. Flour milling and meat packing are two of its leading industries.

With its suburbs, Winnipeg has a population of 535,000. The city is the site of the University of Manitoba. Winnipeg was founded as a fur-trading station by the French in 1738. Its first name was *Fort Rouge,* later changed to *Fort Garry.* It was named *Winnipeg* in 1870. The name means *muddy waters* in the language of the Cree Indians. The waters are those of the Red River, which is joined by the Assiniboine at Winnipeg.

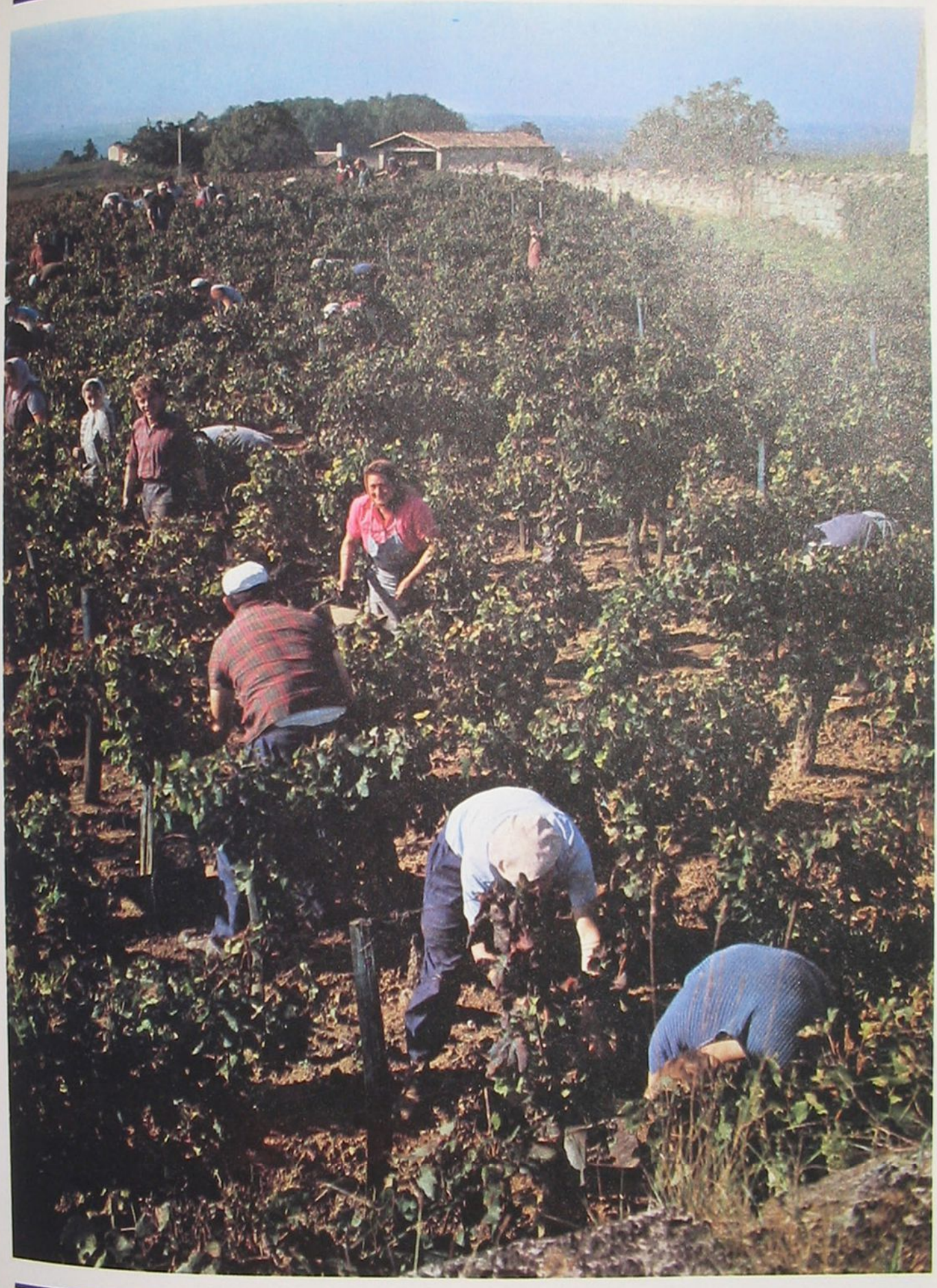
Winnipeg, Lake, is Canada's third largest fresh-water lake. It is situated in Manitoba province, about 35 miles north of Winnipeg city. The lake is fed by many rivers, including the Red, Winnipeg and Saskatchewan rivers. Water leaves it through the Nelson River in the north, eventually flowing into Hudson Bay.

Lake Winnipeg has an area of 9,398 square miles. It is over 250 miles long. Its waters are a rich fishing ground. There are swimming beaches along the south-western shore. In prehistoric times it was part of a larger glacial lake.

Opposite: Grape pickers in a French vineyard. The *vendange,* or picking and pressing the grapes, takes place in late September or early October.

Wine is the fermented juice of fresh ripe grapes. After gathering, grapes must be pressed quickly, before fermentation begins. Almost everywhere, grapes are now pressed by mechanical means, but 'treading the grapes' was once a colourful if tiring process in all grape growing countries. Grape-juice, called *must,* runs into containers called *vats,* where it ferments. White grapes produce white wine, but black grapes produce both red and white wine. The colour comes from the skins, not the juice. *Rose* (pink) wine is made from black grapes, the skins of which have been removed when the juice in the vat has reached the right colour. In fermentation, yeast cells on the skins change sugar in the grape juice into alcohol and carbon dioxide. The carbon dioxide is lost as gas bubbles. Pips and stalks sink to the bottom of the vats, from where they can be removed.

Wines are of many kinds, depending upon such factors as climate and soil. Some are blended with other wines, and some are *fortified* (mixed with distilled wine called *grape brandy*). The grape harvest is called the *vintage,* and most wines improve with age. Wine connoisseurs know whether a particular vintage year was good or bad, the quality depending mainly upon weather. Italy and France are leading wine-producing countries.

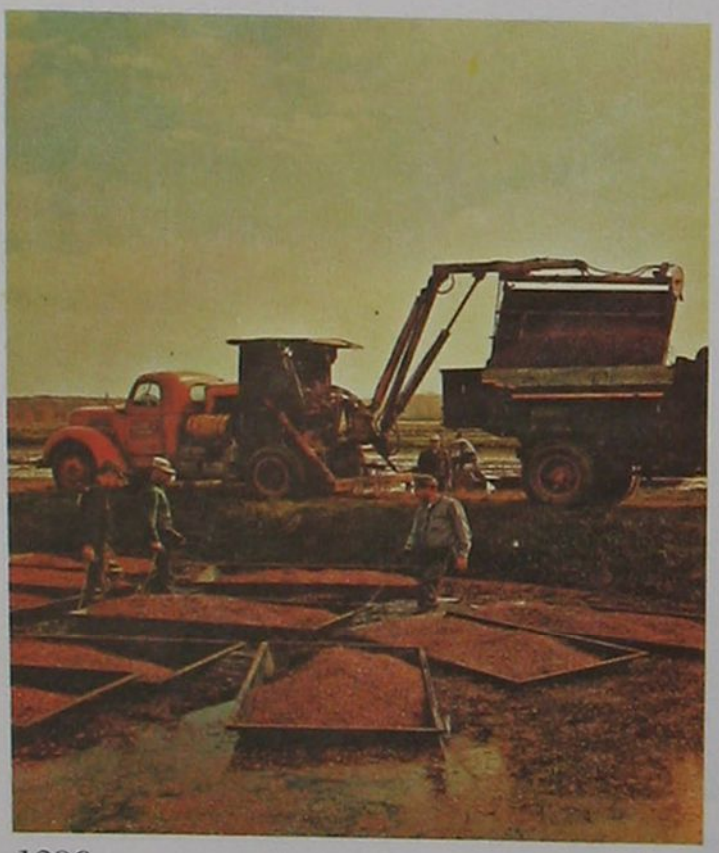


Wire Several metals, called *ductile* metals, can be stretched and stretched until they form thin wire. Copper is one of the most ductile of the common metals and is widely used in this form in all kinds of electrical work.

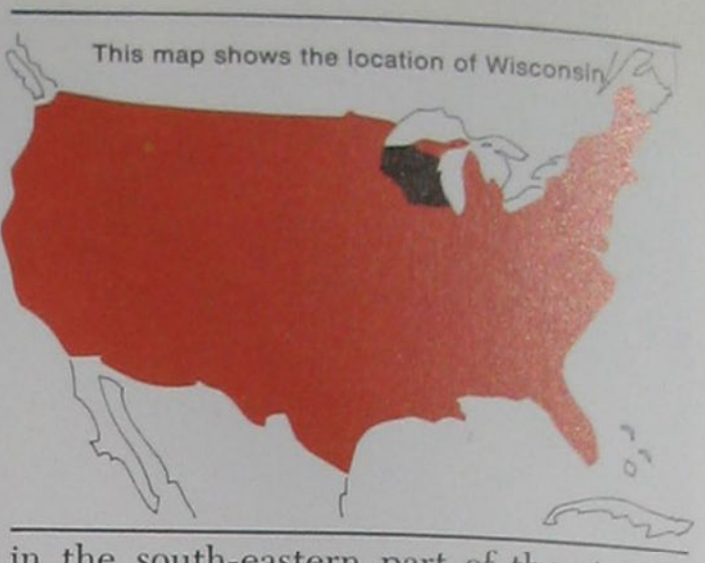
Iron and steel wires are widely used for such things as barbed wire and other kinds of wire fencing. They are usually galvanized (coated with zinc) to prevent rusting.

In the first stage of wire making, ingots of hot metal are rolled until they form rods about a quarter of an inch in diameter. The rods are then drawn cold through successively smaller and smaller holes in metal formers, or dies, until they become wire.

Wisconsin is a Midwestern state of the United States. It borders lakes Superior and Michigan, two of the Great Lakes. Hundreds of interior lakes and beautiful woodland areas attract holidaymakers and sportsmen to the state. The area of Wisconsin is 56,154 square miles, and its population is 4,418,000. Most people live



Harvesting cranberries in central Wisconsin.



in the south-eastern part of the state in cities such as Madison, the state capital, and Milwaukee, the largest city, home of many German-Americans.

Wisconsin produces more milk and cheese than any other state in the Union, but industry, including paper making, engineering, and food canning, is its main source of income.

The French explored Wisconsin in the 1600's and claimed the region first. Britain won it in 1763. Wisconsin became a state in 1848.

Wolf The wolf is a flesh-eating mammal that is closely related to the domestic dog. In fact, it looks like a large Alsatian, or German shepherd dog. When fully grown, a wolf stands 2½ feet high at the shoulder and weighs over 100 pounds. It has a long snout, powerful jaws, and erect ears. Wolves have thick fur that may be anything from black to white in colour. Those of the cold Arctic generally have lighter colouring. Some in North America have reddish fur. They are smaller than the grey and arctic wolves and belong to a different species.

Wolves generally live in packs of up to 30 animals, which are, in fact, family

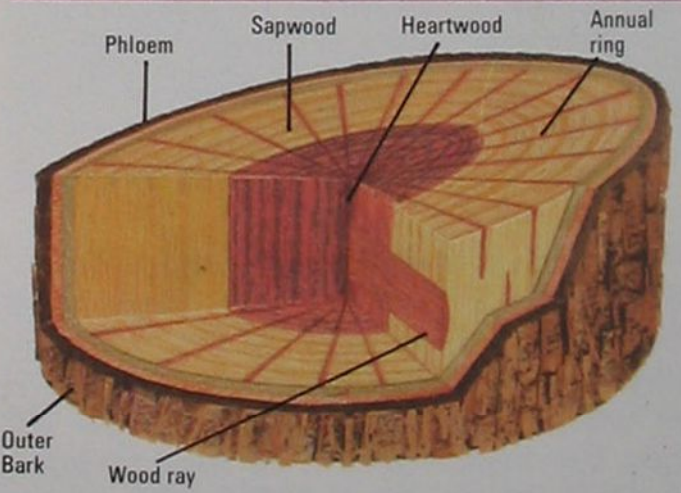
As wolves attack and kill sheep and other farm animals, bounties have been offered for their pelts. This encourages people to go out and kill the animals to collect the reward. In North America many wolves have been killed by farmers and ranchers. They have been driven out of all inhabited areas and are now facing complete extinction.

A family of wolves. In the wild they generally live in groups or packs of some thirty animals. Once common in many parts of North America, Asia, and Europe, civilization has driven them into the far northern lands.

groups. They hunt together, killing small animals and even deer. They will attack domestic animals such as sheep, and for this reason Man has always tried to exterminate wolves. At one time they lived in most parts of Asia, Europe and North America. Now, however, they have been driven mainly into the far north.

Wolfe, James (1727-1759), was a British soldier who commanded the forces that won Canada for Britain. In 1759, after distinguishing himself at the siege of Louisburg, where he commanded a brigade, Wolfe was chosen by William Pitt the Elder to lead an attack on the French in the St. Lawrence region of Canada. He advanced on the strongly held city of Quebec and besieged it for 12 weeks. Eventually his men were able to climb the Heights of Abraham, above the city, and launch a successful attack. Both Wolfe and the opposing French general, Louis de Montcalm, were killed.

Wood is one of Man's most valuable raw materials. It is used in building, in making furniture, and even burned as a fuel. Wood is tough, rigid, and heat resistant. It can be chiselled or sawn to any size or form. When properly prepared it does not shrink or stretch, will not buckle, and is resistant to insect attack and decay.



Cross-section through a tree trunk. The radial strips are called wood *rays*. Simple woods have their rays a single cell thick. In more complicated wood the rays are dozens of cells in width.

Wood forms the bulk of the stems, roots and branches of trees and shrubs. In these plants it performs two functions: it gives the growing stem support and enables the plant to grow to great and advantageous height, and it conducts water from the roots to the leaves. Wood consists of thick-walled cells called *xylem*, flecked with occasional strands of thin-walled *wood parenchyma* cells.

The wood of any fair-sized tree occupies almost the entire trunk. A sleeve of *phloem tissue*, which is responsible for carrying food in solution, surrounds the solid wood core, and outside the phloem there is a ring of bark. New wood is being produced almost all the time by a single layer of cells called the cambium between the phloem and the xylem.

In almost all the trees that grow in regions where the climate varies markedly through the year, the wood shows a number of *growth rings*. In spring, xylem cells are wide because they need to cope with the large amount of sap which the tree needs. In summer and autumn, however, this need is not so great and the xylem cells produced at this time are much narrower. When spring comes again wide xylem cells abut the narrow ones of the previous autumn and make a clear ring.

The consistency of wood varies greatly. The South African ironwood is so hard that it is almost impossible to hammer a nail into it. It is as much as ten times heavier than balsa, one of the lightest of woods. Wood is very durable because few organisms can digest it. The oldest living tree is the bristlecone pine of California. Some specimens are known to be over 3,000 years old.

Woodpeckers form a large family of birds. They drill or 'peck' at tree trunks with their long, pointed bills. In this way they uncover the tree-living insects and grubs on which many of them feed. They extract the insects with their long tongues. Their tongues have barbs and sticky material on the end. Some kinds of woodpeckers live on nuts and berries. Woodpeckers also chip away at trees to reach the hollows inside where they can make their nests.

Woodpeckers can climb easily. Their toes are arranged to help them grip the bark, and their stiff tail feathers give support. In flight, woodpeckers move up and down because they alternate between moving their wings and gliding.

There are over 200 species (kinds) of woodpeckers. They inhabit every continent except Australia. Many kinds are black and white. Often the males have red patches on their heads. The most common woodpeckers in Europe include the green woodpecker and the greater and lesser spotted woodpeckers.

Woodwind instruments are so called because at one time they were all made of wood. Today, they are made of metal, or a combination of metal and wood. Plastic is widely used for cheaper instruments. All woodwind instruments are fashioned in the shape of a cylinder or cone, though this may be bent back on itself or curved round. Woodwind players blow into their instruments, causing the column of air inside to vibrate and produce a musical sound. The player's fingers cover holes or keys to alter the length of the vibrating air column. This changes the *pitch* (highness or lowness) of the note.

In some woodwind instruments, a thin *reed* (strip of cane or wood) or pair of reeds in the mouthpiece vibrates too, giving the sound a different quality. The woodwinds can be classified in families according to the presence or absence of reeds and the number of them.

The *flute* family of reedless instruments has a high, sweet, birdlike tone. Both the flute itself and the *piccolo* (smaller in size and higher in tone) are usually made of metal and are held horizontally, the player blowing across the mouthpiece. This kind of flute came into use during the early 18th century, eventually replacing the *recorder*. The *clarinet* family of single-reed instruments includes the clarinet and the *saxophone*, of which there are several sizes.

A group of girls playing recorders. The recorder is a simple woodwind instrument with a clear tone. It is easy to play and is popular in schools. Once used in chamber music, it lost popularity to the flute.

The *oboe* family of double-reed instruments includes the oboe; the lower, mournful sounding *cor anglais* (English horn); and the very low *bassoon* and *contra bassoon*.

Wool is the fibre that comes from the coat of the sheep. Some wool comes from goats and camels. Clothing made from wool is warm and light, and is comfortable to wear. Wool is more useful than any other animal hair because it has a resilient curl or *crimp*, so that it keeps its shape. And each fibre has scales so that the fibres interlock when they are spun into yarn.

Most wool comes from sheep, which can live in all temperate parts of the world. Merino sheep have the finest and largest amounts of wool. A merino sheep yields up to 30 pounds of wool at one shearing – enough to make about seven overcoats. From goats we get angora, or mohair, and cashmere wool.

A sheep is usually sheared of its coat once a year, although shearing is done twice a year in hot countries. A good sheep shearer can remove the fleece in 2½ minutes using an electric shearing tool. The best fleece comes from lambs. Wool also comes from sheep slaughtered for their meat, but this wool is of poorer quality than wool sheared from live sheep.

Before it is made into wool for knitting, the fleece must be graded. Buyers look at the length, fineness and strength of the fibres, and the colour. The best wool has fine, strong, and long fibres, and is pure white in colour.

The fleece now goes to a mill for processing. Each fleece is first torn apart by a sorter. He makes piles of wool of various grades of coarseness. Each pile of wool is then cleaned thoroughly. It may then be dyed and blended with other kinds of wool if necessary.

The next stage is to oil the wool to restore its resilience after cleaning. It is then combed in a *carding* machine into parallel rows of fibres. The fibres

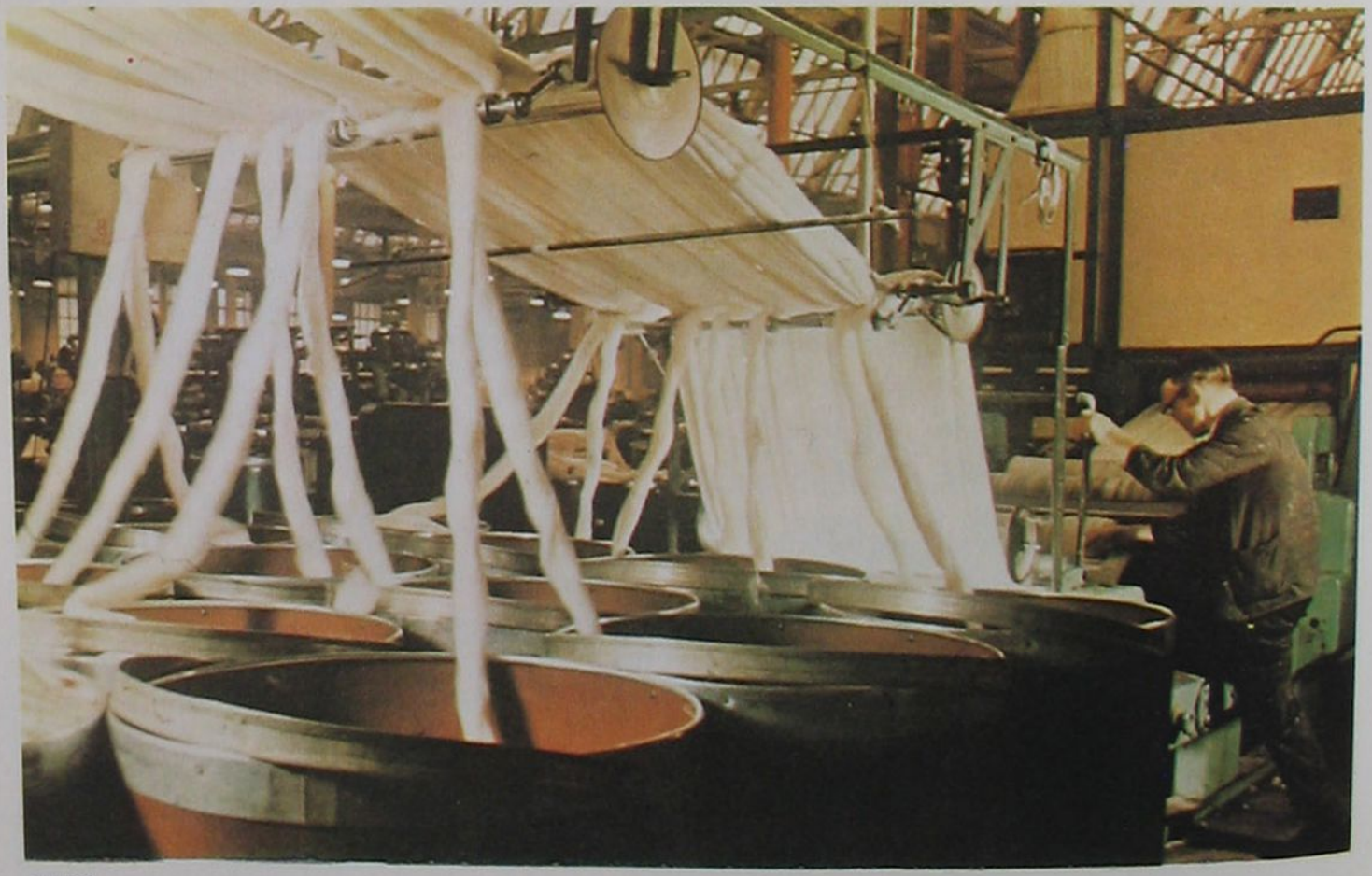
are twisted together to make yarn, which can then be knitted into garments, rugs, blankets, and carpets. If the combing is very severe, the strong firm cloth called *worsted* results. If the combing is light, a soft, fuzzy yarn is made.

Manufacturers produce three kinds of wool depending on its origin. *Virgin wool* is wool that has never been used before. *Reprocessed wool* is wool that has been knitted into unsold products and then respun. *Reused wool* is wool that has been made up and used or worn, then respun.

Worcestershire (area 700 square miles), a county in the West Midlands of England, is noted for its market gardens and orchards. Its county town is Worcester, and its population is 692,600.

The Cotswold Hills lie in the south-east of the county, the Malvern Hills in

Left: A sheep shearer at work. An expert can shear some 200 sheep in a single day. Below: On arrival at the mill the wool is sorted and then washed or scoured. The fibres are then separated in a carding machine into long bands or slivers. Here the slivers are being given a second wash to remove final traces of dirt and grease.



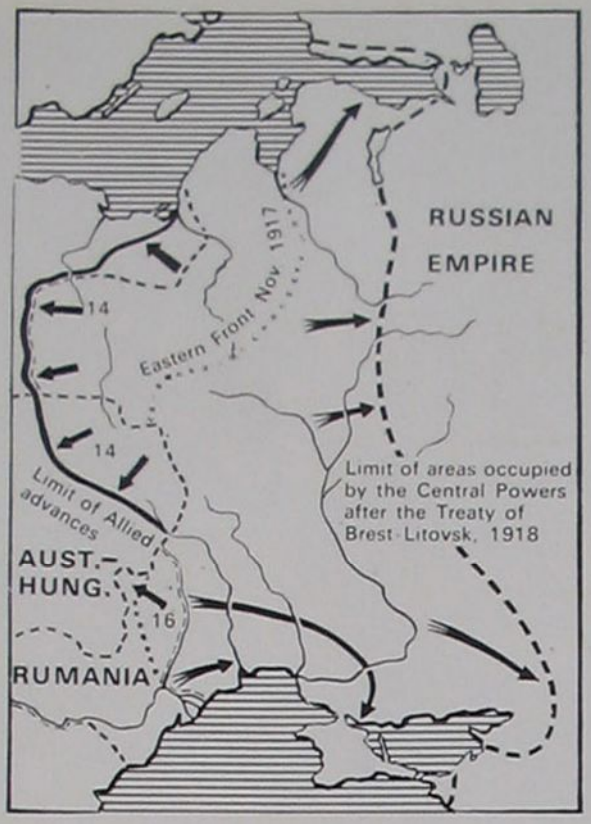
The village of Broadchalk in Worcestershire. This is one of the major fruit-growing and market-gardening areas of England, famous for orchards and asparagus.

the south-west and the Clent Hills in the north. They surround the valleys of the River Severn and the Warwickshire Avon, and those of their tributaries—the Stour and the Teme. The rich, fertile soil that covers most of the rolling countryside supports mixed farming, and fruit, vegetable and hop growing. The Vale of Evesham, along the Avon, is particularly well known for its fruit.

World War I started when an Austrian Grand Duke was assassinated at Sarajevo in Serbia. Austria attacked Serbia, and Russia came to Serbia's help. This led to a world war because Europe had been divided into two armed camps by rivalry over colonies. Great Britain and France, the two great colonial powers, were in one alliance with Russia. Germany and Austria-Hungary, with only a few colonies, were in another alliance. Both sides had been building up their armies and navies. Rivalry over naval power was a cause of jealousy between Britain and Germany. Turkey and Bulgaria joined Germany. Italy and many other countries came in on the other side.

There was fighting in both eastern and western Europe. The German advance into France, through Belgium, was stopped in 1914. The Western Front, from the Belgian coast to Switzerland came into existence. It was fortified by both sides with trenches, barbed wire and artillery. For three and a half years there was a stalemate. Neither side could advance more than a few miles. New weapons like poison gas, used by the Germans at Ypres in April 1915, and tanks, used by the British on the Somme in September 1916, made little difference. Millions of lives were lost in useless offensives at Verdun and on the Somme in 1916, and at Passchendaele in 1917. Aircraft were used, but mainly for reconnaissance until nearly the end of the war.

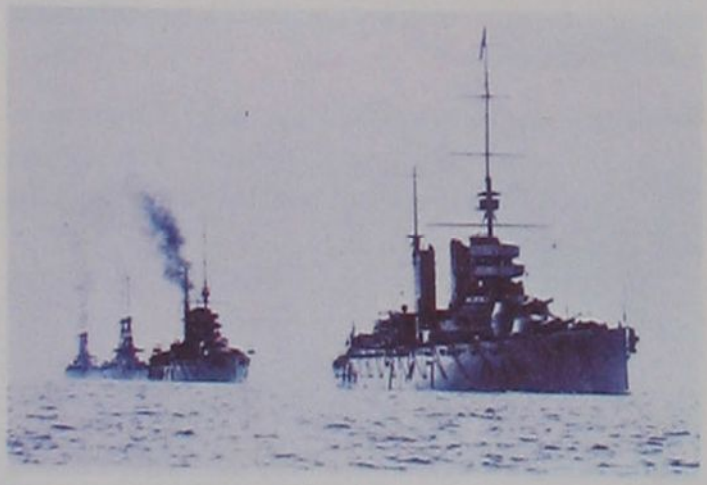
On the Eastern Front the war was more



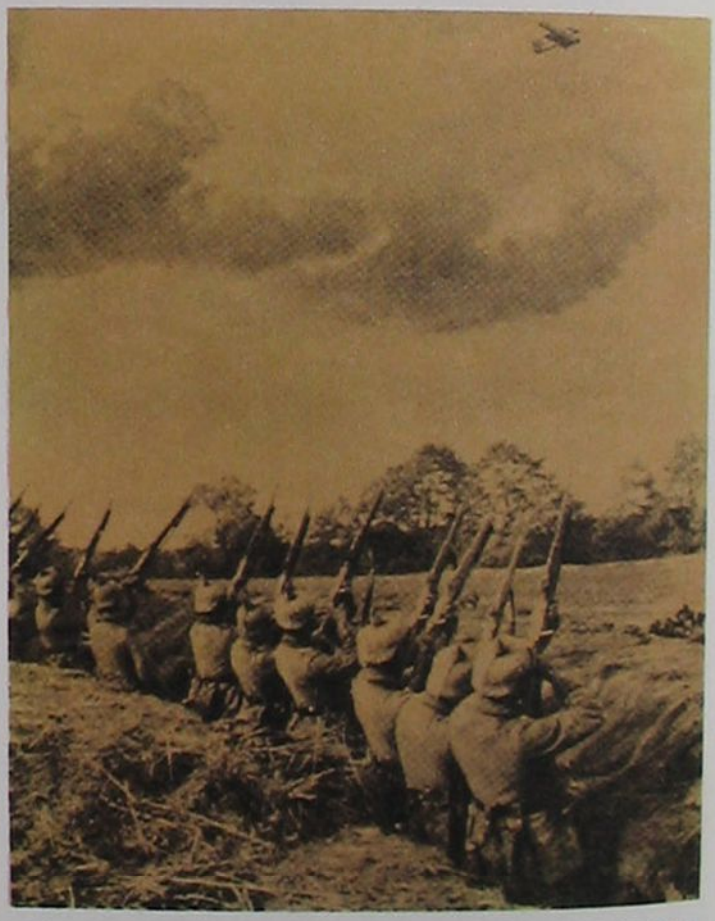
Left: Field-Marshal Sir Douglas Haig, later Lord Haig, British Commander-in-Chief (1915-19). Haig has suffered much criticism for lack of imagination and foresight, but he was by no means as incompetent as has sometimes been suggested.

Below: The British Expeditionary Force on their arrival at Boulogne, in 1914.

War at sea. Admiral Beatty's Battle-cruiser Squadron in line astern. In fact, Jutland was the only important naval battle of the war.



Trench warfare. A British stretcher party carrying a casualty through a French line on a defended road.



This extraordinary photograph shows German infantry attacking a primitive-looking Russian aeroplane with rifle fire. There was little hope of bringing it down, but the object was to drive the aircraft up to heights from which it could not observe.

mobile. Russia advanced into Austria, but was heavily defeated by Germany at Tannenberg. In 1915, the British tried to relieve the pressure on Russia by invading Turkey through a landing at Gallipoli. It was a costly failure. Allied attacks on Turkey in Mesopotamia and Palestine were more successful, but the Turks only began to retreat in 1918.

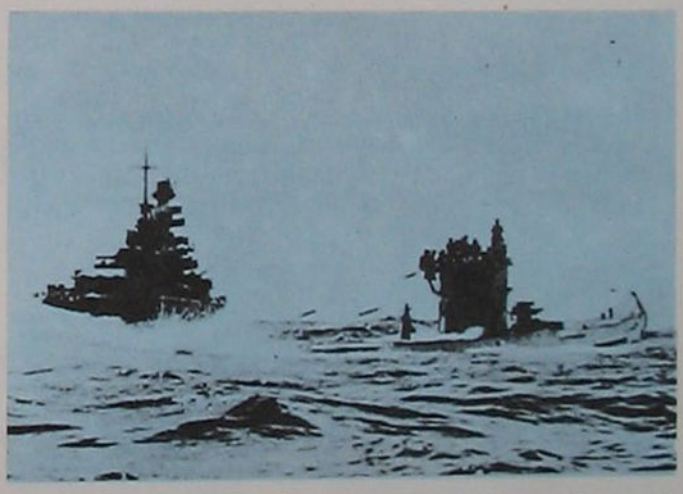
There was only one full scale battle at sea, in 1916, when the British and German fleets met at Jutland. The British had the biggest losses but the German fleet returned to harbour. German submarines nearly starved Britain in 1917 by sinking food ships. The USA joined the war against Germany in 1917, because German submarines sank neutral ships.

The strain of war on Russia, a badly governed and bankrupt country, resulted in revolution. In December 1917, the new Bolshevik government arranged an armistice with Germany, and in March 1918 they made peace. This allowed German troops to be moved to the Western Front, where, in March 1918, the last German offensive was launched. It failed, and an Allied offensive, helped by the new American armies, began in July. In September, the German lines broke and the Italian army defeated the Austrians. German civilians were suffering badly from the Allied blockade and the loss of merchant ships. In November 1918, the German General Staff obtained an armistice. The Treaty of Versailles and other peace treaties were signed in 1919-20.

The Central Powers (Germany and her allies) lost 3,300,000 dead; 8,250,000 were wounded. The Allies lost over 4,500,000 dead; 11,250,000 were wounded.

Many new weapons were developed during World War I. Tanks were used for the first time by the British Army. Initially these caused the enemy much concern, but they were able later to find weapons that were effective against them. The submarine also came into widespread use for the first time, and the German submarine attacks on neutral shipping finally caused the entry of the United States into the war. Aircraft were also used for the first time, only for reconnaissance purposes to start with, but later to carry bombs.

Top: The Supermarine Spitfire was one of the most famous aircraft of World War II. This Mark V B was stationed in the Middle East.
Above: A howitzer in action at night during the Italian campaign.
Below: The Germans almost succeeded in their attempt to blockade Britain. Here a German U-boat meets up with a heavy cruiser.



World War II began on September 1, 1939 and officially ended on September 2, 1945. It was fought between Germany, Italy and Japan (the Axis) and the Allies who described themselves from January 1942 as the United Nations. The main

Allied powers were Britain and the Commonwealth, France, the USA and USSR.

The war began with the German invasion of Poland which was conquered in four weeks. Britain and France declared war on Germany on September 3, 1939 but were unable to help the Poles; the real fighting began with the German attack on Denmark, Norway, France and the Low Countries in April-May 1940. They were swiftly conquered. After France fell in June 1940, Germany was unable to gain air mastery over the English Channel ('Battle of Britain', summer 1940) and had to abandon the invasion of Britain.

Italy joined Germany in June 1940. Her attack on Egypt was repulsed. Italian troops invaded Greece in October 1940 but Greece was only occupied after German forces arrived in April 1941. In the same month Yugoslavia was occupied by Germany. A new phase of the war began on June 22, 1941 when the Germans invaded the USSR on a 1,500 mile front from the Baltic to the Black Sea. By December they stood outside Leningrad, Moscow and Rostov. The German troops were however ill-equipped for a winter campaign and suffered huge losses.

The next major turning point of the war came with the Japanese attack on Pearl

Allied Lines
May 7th, 1945
Arrows Show Direction of Allied Advance
The Axis Powers
Areas Occupied by the Axis Powers
The Allies
Areas Occupied by the Allies
Vichy Controlled Areas (Later to Allies)

World War II. European and North African Theatres

Three RAF Stirling bombers. These aircraft carried a crew of seven or eight and could carry 14,000 lb of bombs as well as eight machine guns. Their first raid took place in February 1941 on Cologne.

Harbor, the main USA naval base in the Pacific, on December 7, 1941. The USA under President Roosevelt now joined in the war against the Axis. It became the main source of war materials for the Allies. The Japanese troops were very well trained and equipped and achieved great success in south-east Asia; by May 1942 they threatened Australia.

Until the autumn of 1942 the Allies were on the defensive, but from the defeat of the Axis forces at El Alamein in October 1942, and the victory of Stalingrad by the Soviet troops at the end of January 1943, the Allied position began slowly to improve. For the next two years Soviet armies advanced towards the territory of Germany and her allies, fighting with and destroying the majority of the Axis forces. The Americans landed in French North Africa in November 1942 and in May 1943 Axis resistance in North Africa ended. Stalin wanted the British and Americans to establish a 'Second Front' in north-west Europe but the western Allies insisted on fighting in the Mediterranean. The conquest of Sicily was followed by the invasion of

Below: 1943. Churchill and Roosevelt discussing with the Governor-General of Canada and the Canadian Prime Minister the proposed invasion of Europe which was planned for the following year.

IMPORTANT DATES AND EVENTS OF WORLD WAR II

September 1, 1939	German forces invaded Poland and World War II began.
September 3, 1939	Britain and France declared war on Germany.
September 29, 1939	Germany and the U.S.S.R., Germany's ally at the time, divided Poland between them.
April 9, 1940	German forces invaded Denmark and Norway. Allied troops helping Norway were defeated.
May 10, 1940	Belgium, Luxembourg and Netherlands were invaded by Germany.
June 4, 1940	Allied troops retreated to Dunkirk in France and were evacuated by a fleet of small boats.
June 22, 1940	France surrendered to Germany and a French government of collaboration was set up at Vichy.
August, 1940	The Battle of Britain. A German bombing offensive began, but failed to defeat Britain.
March 11, 1941	President Roosevelt signed the Lend-lease Bill to aid Britain.
April 6, 1941	Germany attacked Yugoslavia and Greece and handed Greece over to Italy.
June 22, 1941	Germany turned against its Russian ally and Axis troops invaded the U.S.S.R.
September 16, 1941	German forces attacked Stalingrad in the U.S.S.R. Fighting continued for more than a year.
December 7, 1941	Japan attacked Pearl Harbor. Two days later, the United States declared war on Japan.
June 4-6, 1942	Battle of Midway stopped Japan's eastward expansion.
November 7, 1942	American forces landed in N.W. Africa, while British forces pushed westwards from Egypt.
January 31, 1943	The last German forces in Stalingrad surrendered to the Russian army.
February 9, 1943	American forces cleared the Japanese from Guadalcanal Island.
May 17, 1943	The German Army in North Africa finally collapsed.
July 10, 1943	The Italian dictator, Benito Mussolini, was overthrown. Mussolini was rescued by the Germans.
August 17, 1943	The Allies occupied the island of Sicily after 39 days of fighting.
September 7, 1943	Italy surrendered when Allied forces landed on the Italian mainland.
June 6, 1944	D-Day: 4,000 ships landed Allied troops in France.
July 20, 1944	German generals unsuccessfully attempted to kill Adolf Hitler with a bomb.
January, 1945	American troops stopped a German offensive in Belgium in the Battle of the Bulge.
February 19, 1945	United States Marines took Iwo Jima island by storm.
April 1, 1945	American forces landed on the Japanese island of Okinawa.
April 12, 1945	President Roosevelt died. His vice-president, Harry S. Truman, became president.
April 25, 1945	Russian forces marching from the east and Allied troops from the west met at Torgua, Germany.
May 8, 1945	All German resistance ended after the suicide of Hitler and the capture of Berlin.
June 26, 1945	Fifty nations signed the United Nations charter in San Francisco.
August 8, 1945	Hiroshima, Japan, was destroyed by an atomic bomb. Nagasaki was bombed three days later.
August 8, 1945	The U.S.S.R. declared war on Japan.
August 14, 1945	Japan surrendered to the Allies unconditionally and signed the surrender agreement on September 2.

Italy on September 3, 1943. Substantial German reinforcements resisted the Allied advance northwards until April 1945.

On June 6, 1944 the western Allies launched the second front, under the command of General Eisenhower. The Allies had air and naval control over the English Channel. In three weeks the Allies landed a million men along 50 miles of the Normandy coast. Paris was liberated in August. An airborne landing at Arnhem failed in September 1944 and the Germans counter-attacked in mid-September in the Ardennes. This delayed the crossing of the River Rhine, but Germany was now being heavily attacked from the east by the Soviet forces and resistance became impossible. The Soviet and western forces met at Torgau on the River Elbe on April 25.

Left: American bazooka men knock out a German tank during the Invasion of Normandy, 1944.

On May 7, 1945 the German high command surrendered at Rheims at General Eisenhower's headquarters.

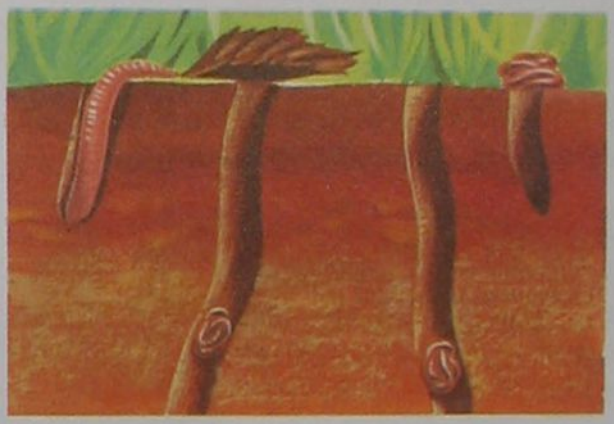
In the Pacific War, the decisive American victory at sea and on land occurred at Leyte in the Philippines in October 1944; half the Japanese fleet was destroyed in this battle. In June 1945 Japanese resistance in Okinawa ended. From this island air bombardment of the Japanese homeland began. Japan was called to surrender unconditionally but failed to do so. On August 8, the first atomic bomb was dropped on Hiroshima. Two days later the USSR declared war on Japan. On August 9 the second atomic bomb was dropped on Nagasaki. On August 14 the Japanese stopped fighting and surrendered at Tokyo Bay on September 2. So ended the most destructive war in history.

Worms are soft-bodied animals that live in the ground or in water, or as parasites in plants, animals and men. The maggots (larvae) of insects look like worms, but true worms belong to other groups of animals. There are four major groups of worms: flatworms, segmented worms, roundworms and ribbon worms.

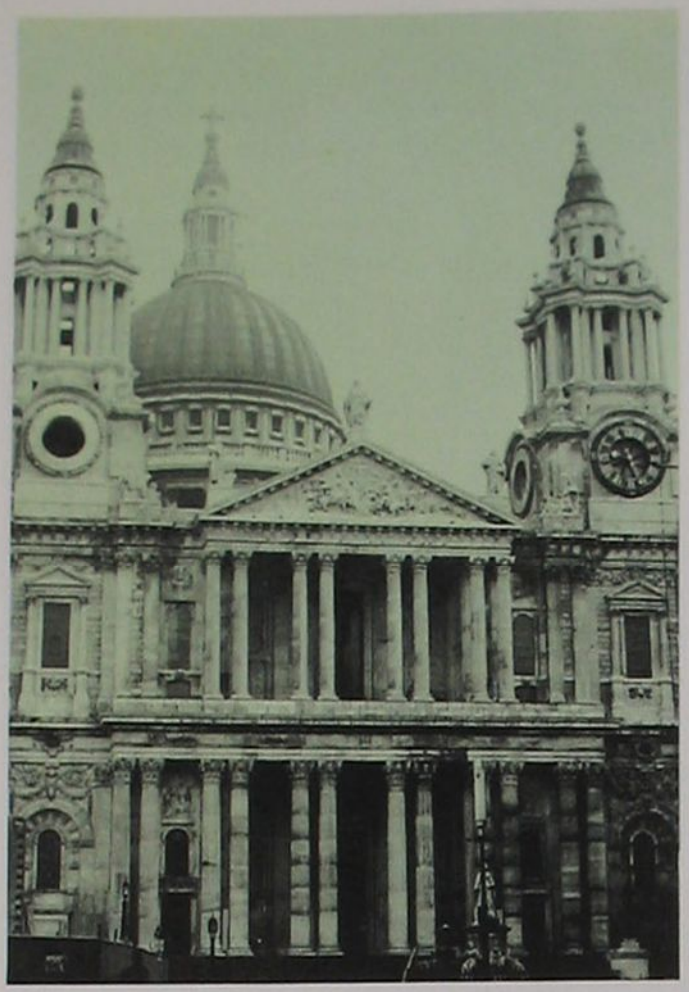
Flatworms are of three kinds: planarians, flukes and tapeworms. Planarians live in ponds and streams and can be found gliding about under stones or floating leaves. They also live in moist soil and in the sea. Planarians have considerable powers of *regeneration*. They can be cut into several pieces and each piece will grow into a new animal. Flukes are parasitic worms—they live in or on a variety of animals. Liver flukes are serious parasites of sheep, and the tropical disease *bilharzia* is carried by blood flukes. Tapeworms live in the intestines of animals and sometimes men. They have no mouth or stomach and simply absorb digested food from their hosts. The tapeworm enters its host as an egg, usually in meat eaten by the host. It hatches, and attaches itself to the intestine wall with small hooks. It then starts to grow and may reach many feet in length. They are harmful to their hosts as they prevent them from getting nourishment from their food.

Segmented worms are also of three kinds: earthworms, bristle-worms and leeches. Earthworms live in the soil, and feed by passing soil through their bodies and digesting food particles in the soil. They are useful animals because they turn over the soil. Bristle-worms include the ragworms and lugworms found on beaches, and sabella, a worm that lives in a tube on the sea-floor, spreading a set of feathery tentacles out of the top of the tube. Leeches are parasitic worms that feed on the blood and body fluids of other animals.

Roundworms include eelworms, which live freely or as parasites in plants and animals, often causing injury. *Ribbon-worms* are mostly marine worms and have a strange long proboscis, or nose, used for defence and as a feeler.



Above: A diagram to show the aerating and ploughing action of earthworms in the soil.
Below: A terebellid worm. The colourful tentacles on the head are modified for capturing small food particles. The tube is normally buried in the sand.

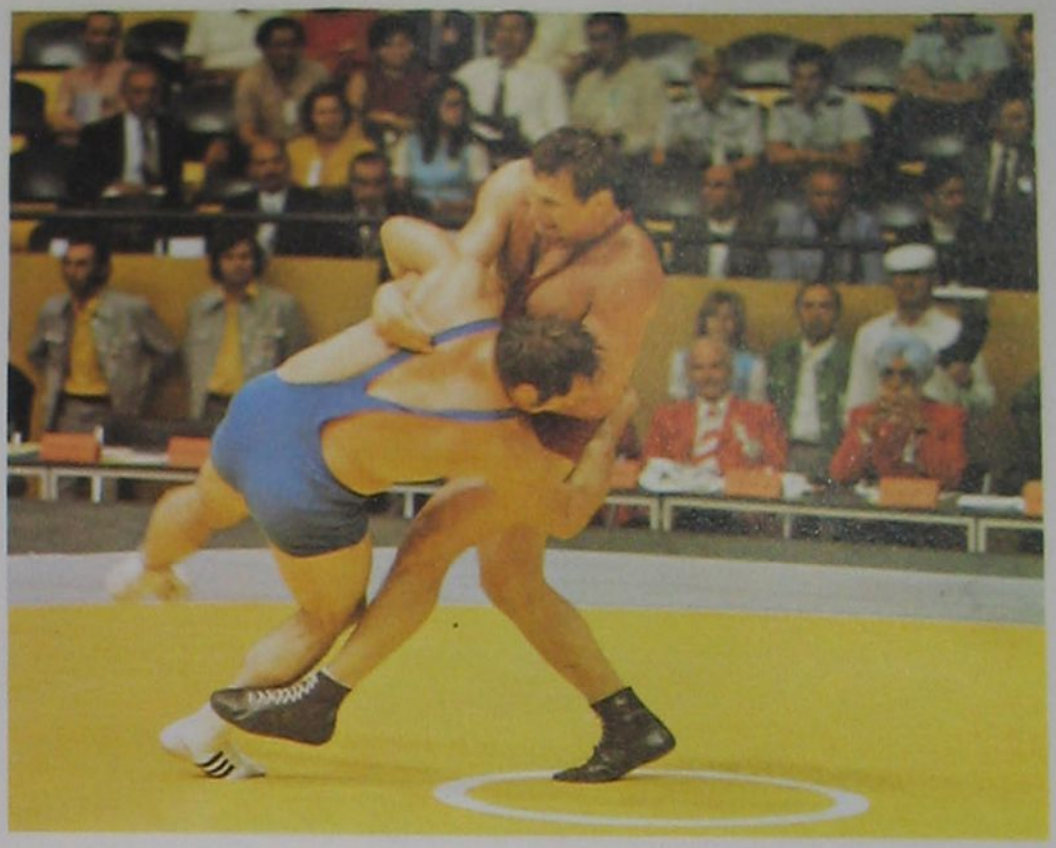


Wren, Sir Christopher (1632-1723), was one of the most brilliant of all English architects. He was responsible for the design of many famous and beautiful buildings, perhaps the most celebrated being St. Paul's Cathedral in London.

As a student at Oxford he distinguished himself in physics, mathematics, and astronomy. He later became a professor of astronomy at both London and Oxford. In 1663 the first buildings to be erected from his plans were begun. These were the chapel at Pembroke College, Cambridge, and the Sheldonian Theatre at Oxford.

It was the Great Fire of London in 1666 that gave Wren so many opportunities. St. Paul's had been destroyed along with numerous other buildings. Wren made detailed plans for an exciting new City of London, but these were never carried out because of opposition from property owners. The design of the new St. Paul's took him many years and it was

Above: St Paul's Cathedral, the best known of all Sir Christopher Wren's buildings. Not so famous is the Royal Hospital, Chelsea (right), founded by Charles II and home of the 'Chelsea Pensioners', or old soldiers. This was also designed by Wren, on the banks of the Thames.



A wrestling match during the 1972 Olympic Games.

finally completed in 1710. Wren also built more than fifty other churches to replace those ruined by the fire. They show an astonishing variety of styles and in particular of tower designs. A number of these buildings were destroyed during the blitz by the Germans in the Second World War.

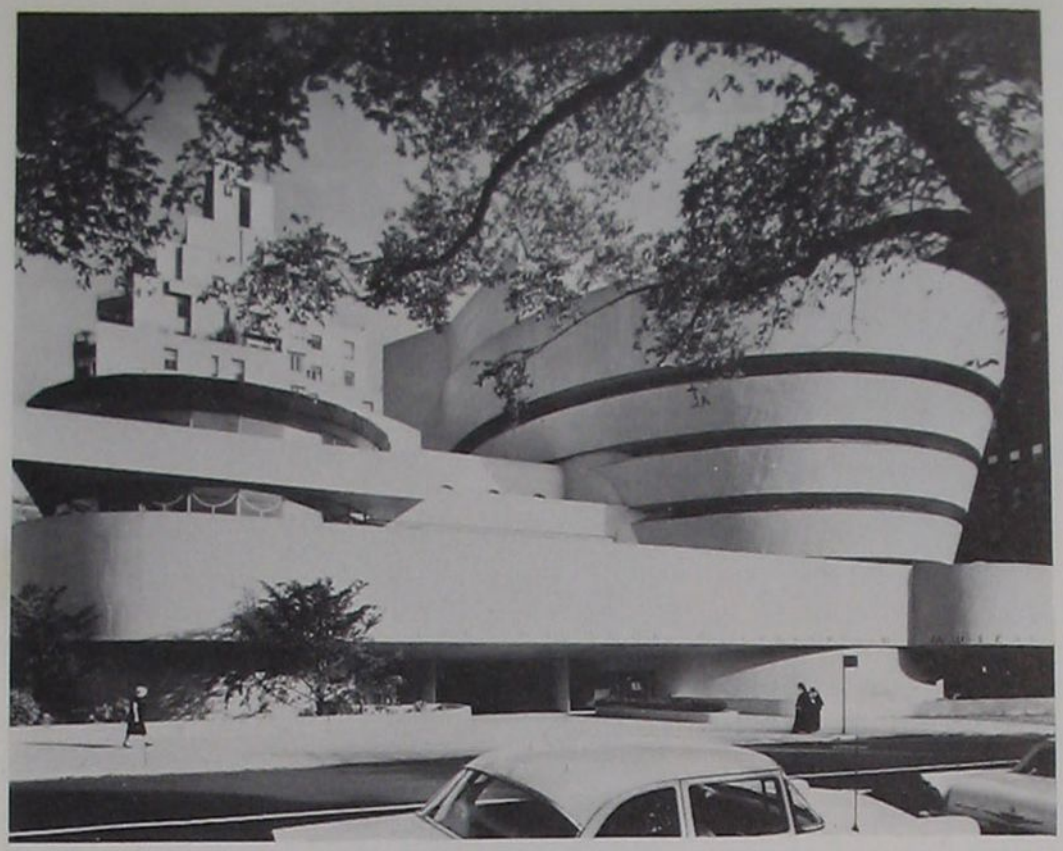
Among his other notable works were Greenwich Observatory, Kensington Palace, Marlborough House, the Ashmolean Museum, and a new addition to Hampton Court.

Wren was knighted in 1672 and made president of the Royal Society in 1680. During the following years he was put in charge of the works at Windsor Castle and made surveyor-general of Westminster Abbey. He is buried in St. Paul's Cathedral, and his epitaph, translated from the Latin, reads 'If you seek a monument, look about you'.

Wrestling is individual combat using the bare hands to try to throw an opponent on his back so both his shoulders touch the ground. Like boxers, wrestlers are divided into weight classes and a referee, assisted by judges, awards points for skilful movements. A winner may be found inside nine minutes (amateur) even though neither wrestler gains a fall.

International wrestling takes place on a mat of at least 6 metres (19 ft 8 ins.) by 6 metres, and 10 cm (4 ins.) thick. There are several distinct styles of wrestling, the main amateur ones being Catch-as-Catch-Can (or Free-Style), in which any fair hold, grip or trip to almost any part of the body is permitted; and Greco-Roman, in which no hold below the waist is allowed. Wrestling in its pure form is one of the most ancient sports, not to be confused with All-in Wrestling which is a modern, professional entertainment particularly in the United States and Britain where bouts are frequently televised.

Wrestling is one of Man's most ancient sports. It is an Olympic sport and was first incorporated into the Olympic Games in Greece in about 708 B.C. The great philosopher Plato was reputed to be a keen wrestler as a young man. But it is likely that the sport dates back to prehistoric times. In France, cave drawings have been found which are believed to be between 15,000 and 20,000 years old. These depict figures in various wrestling positions and holds.



The Guggenheim Museum, New York, was designed by Frank Lloyd Wright. He pioneered the use of new materials in flowing designs.

Wright, Frank Lloyd (1869-1959) was an American architect of outstanding brilliance and originality. He described the pattern of his work as 'organic architecture', by which he meant that buildings should harmonize with the people who had to use them, and with the particular environment in which they stood. Wright, an engineer, set up his own practice in architecture at the age of 26. Refusing to revive styles of the past, Wright used new methods and materials to produce buildings that were more suitable to the rapidly changing pattern of life. Most of Wright's work was done in the United States but he influenced architects abroad.

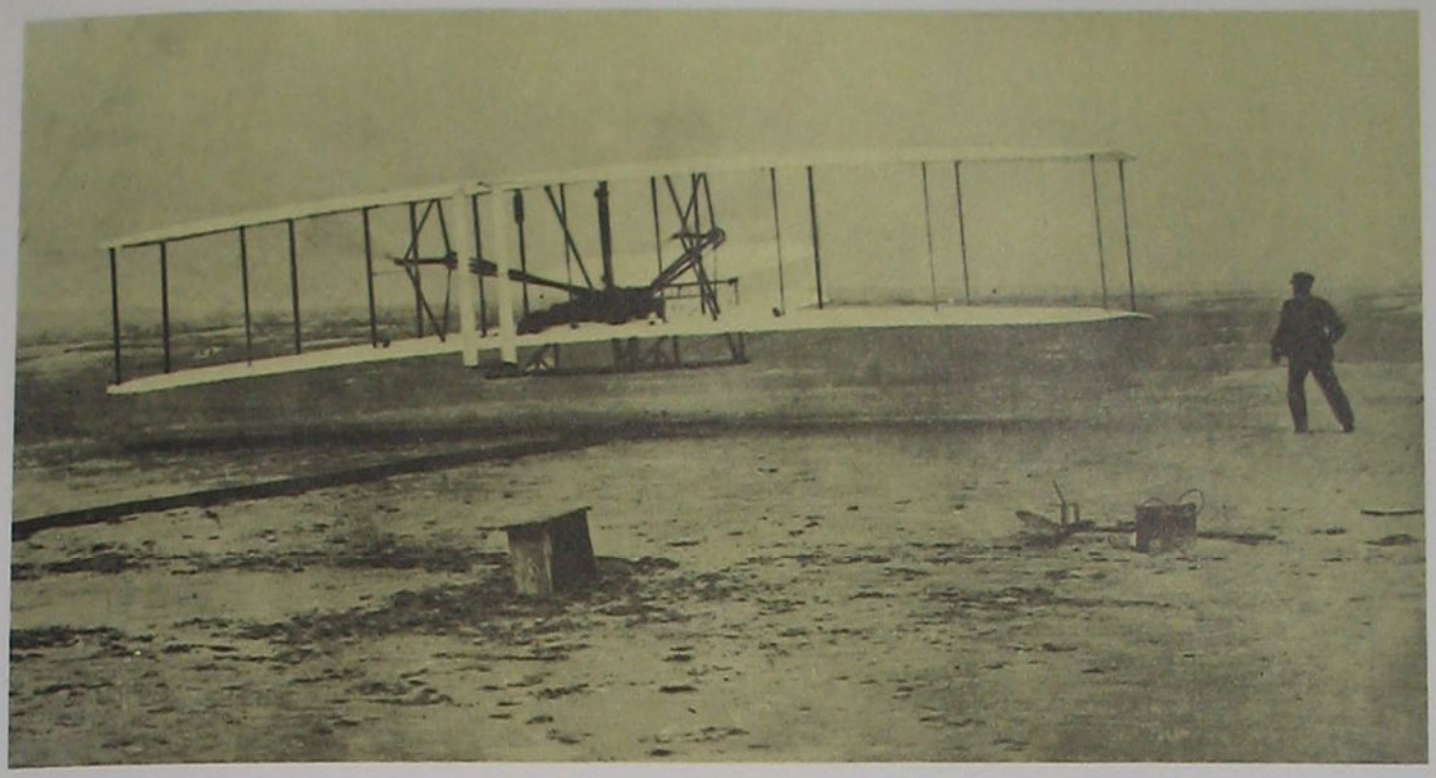
Wright Brothers, Wilbur (1867-1912) and **Orville** (1871-1948), were American flying pioneers. They were the first to successfully make and fly a heavier than air machine. As youngsters, the brothers were intensely interested in everything mechanical and made their own toys. Later on they made their own bicycles and set up in business to sell them.

They became interested in flying after reading about gliding experiments, and they learnt all they could about the subject. Experiments in making a glider soon began. They chose Kitty Hawk, North Carolina, where the weather conditions were most suitable, to test their ideas. After several unsuccessful attempts to get two gliders off the ground, the brothers decided they would have to make many more tests. They constructed a wind tunnel and tested countless numbers of wing models before being satisfied that they had found the correct shapes.

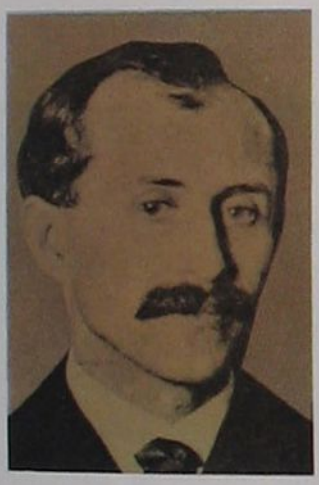
In 1902 they built a third glider with all the corrected features and carried out many glides over several hundred feet. Having achieved success with their glider the brothers determined to make a powered machine. They completed their plane, installed with a petrol-powered engine in 1903 and took it to Kitty Hawk to begin tests.

On December 17, 1903 their plane, piloted by Orville Wright, made a very short but successful flight. During the next few years the Wright Brothers made many flights, which gradually became longer.

They were not taken seriously by the



Above: The first man-carrying flying machine on its first flight, at Kitty Hawk, Carolina, on 17th December 1903. Orville Wright was piloting the machine, which made a short but successful flight. Wilbur watched from the ground. Below: Wilbur (left) and Orville. They started their careers as bicycle salesmen.



United States government until 1908, when they were offered a contract to supply planes to the War Department. The Wright Brothers Company was formed shortly afterwards.

In 1912 Wilbur Wright died of typhoid fever, and Orville continued the experiments alone. Although he gave up his interests in the Wright Brothers Company, Orville spent many years contributing to the development of aviation.

Writing Primitive peoples did not need writing in their everyday affairs, but when the necessity arose they often devised clever means of communicating messages. The Scythians of central Asia once sent to Darius, king of the Persians, a bird, a mouse, a frog, and five arrows. This message meant: 'Can you fly like a bird, hide yourself in the ground like a mouse, and leap through the swamps like a frog? If not, avoid war with us for we shall defeat you with our arrows.'

The Indians of North America communicated with one another by smoke signals, and African tribes by drum beats. The more advanced Incas of South America kept accounts of coded messages upon a *quipu*—a main cord to which several knotted cords were attached. The position of the knots indicated numbers which could be decoded by a hereditary caste of quipu keepers.

Another early way of communicating ideas was by cutting pictures in sand or trees. A picture of a bear might mean simply that bears lived near by or it might be the 'signature' of the bear people—a tribe who used the image of a bear for their sign or *totem*. Some people developed *pictograms* (picture words), and the

Calligraphy: The art of beautiful handwriting. More properly, however, the word is used to denote a free handwriting that fulfils certain aesthetic canons. Calligraphy excludes the style of writing we call "lettering"; that is to say writing carried out with the help of instruments such as ruler, compass, & set square.

Beautiful handwriting has long been admired in many parts of the world. Skilled Chinese writers or calligraphers worked with a brush, not a pen, and their work was highly prized. The medieval monks of Europe kept alive the art of writing, decorating their manuscripts with beautifully coloured pictures known as illuminations. Today, despite the typewriter, many people take great pains to write a 'beautiful hand'.

Chinese and Japanese languages are still based on this system. In ancient Chinese, ⊙ represents the Sun and ☽ the Moon, but in present-day Chinese these pictures have become simplified into 日 and 月. These simplified pictures, and thousands like them, are called *characters*.

In the Middle East, people recorded accounts, laws and contracts in *cuneiform* (wedge-shaped) writing on clay which, when sun-dried or baked, served like a sheet of paper. They devised an extremely efficient system of writing in which letters of an *alphabet* were used to build up an infinite number of words (see Alphabet). Almost the whole world now uses the alphabetical system of writing.

Wycliffe, John (1320?-1384) was an English scholar and priest who attacked the religious and social order of his times. He was a forerunner of the Protestant Reformation. Some people also call Wycliffe an early socialist because he said: 'When Adam delved and Eve span, who was then a gentleman?' Wycliffe thought the Church was too wealthy, and that its property should be taken over by the government. This view made him popular with the Lancastrians – England's royal family. In 1377, when Wycliffe was forced to appear before the Bishop of London to answer a charge of heresy, John of Gaunt

John Wycliffe was known as the 'Morning Star of the Reformation', since his ideas foreshadowed in some ways those of later reformers like Martin Luther.

When they were found, copies of Wycliffe's translation of the Bible were often seized and destroyed, but the means were found to have other copies made. It is amazing to learn that no fewer than 170 manuscripts of parts of the Bible in Wycliffe's version have come down to us. A handwritten copy cost the equivalent of £100 in today's money, but we can buy a printed copy of a Bible for a few pence.

A black bear and its cub hunt for food in Yellowstone National Park, Wyoming.

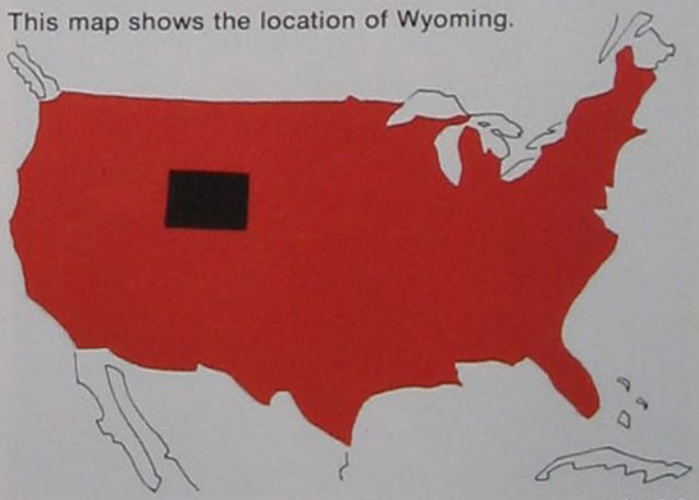
(son of King Edward III) stood by Wycliffe's side protecting him and threatening the Bishop.

Many people took Wycliffe's ideas a stage beyond what he probably intended. These included Wat Tyler and John Ball, who led the Peasants' Revolt in 1381. This revolt convinced Wycliffe that he should communicate his ideas directly to ordinary people. To do this, he produced the first translation of the whole Bible from Latin into English. As another means of informing people of his ideas, Wycliffe sent unordained preachers, called *Lollards*, to talk to people directly. After his death Lollards were persecuted, and the movement died out.

Wyoming is a Rocky Mountain state of the Western United States. It covers an area of 97,914 square miles, and is sparsely populated, with a total of only 332,000 inhabitants. Wyoming is a rugged, somewhat dry state, more suited to rearing cattle and sheep than to growing crops. Many cowboys live and work in the state. But drilling for oil and natural gas is now an even more important activity than ranching. The state capital is Cheyenne.

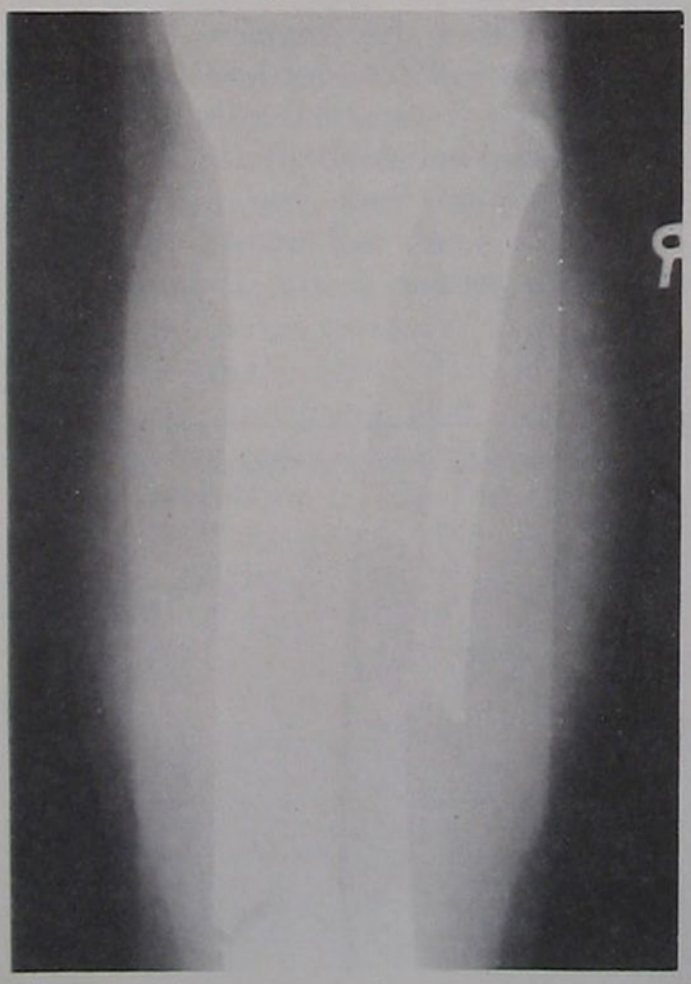
John Colter first explored the region in 1807, and other fur trappers established trading posts there. Settlers came after the 1850's by way of the Oregon, California and other trails. In 1872, Yellowstone National Park, the nation's first park of its kind, and one of the major tourist attractions in the United States, was opened. Wyoming entered the Union in 1890.

This map shows the location of Wyoming.



X

Xavier, St Francis (1506-1552), was a Spanish Jesuit missionary called the 'apostle of the Indies' because he took Christianity to eastern Asia. In 1528, Xavier met Ignatius Loyola, a fellow student at the University of Paris, and later helped him to found the Society of Jesus (the Jesuits). With Loyola, Xavier was ordained a priest at Venice in 1537. At first he preached in Rome, but in 1540 sailed to south-east Asia. He made many converts in Goa (India), Ceylon (now Sri Lanka), Indonesia, Malaysia and Japan. The Chinese eventually allowed him to preach in China, and he died in Canton. The Church made him a saint in 1622, and his feast day is 3rd December.

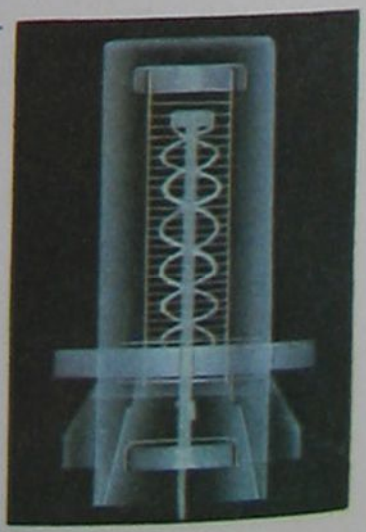


Xerxes (519-465 B.C.) was king of Persia from 485 B.C. Xerxes inherited the throne from his father, Darius I, for whom he had acted as viceroy of the conquered state of Babylon. Xerxes quelled a revolt in Egypt, then tried to conquer Greece and avenge his father's defeat at Marathon. In 480 B.C., Xerxes flung a vast army and fleet against the Greeks. He won a land victory at Thermopylae and marched to Athens but lost the sea battle of Salamis. Despite this defeat, Xerxes had many successes. He died by assassination.

X-rays In 1895 Wilhelm Röntgen was performing a series of experiments in which high-voltage electric currents were being passed through evacuated glass tubes. He noticed that photographic plates left near the tubes were being exposed, even though the plates were covered with metal foil. He decided from further experiments that some invisible form of radiation was able to pass through the metal foil; he called these radiations X-rays.

Today doctors use X-rays to 'see' inside the human body in order to examine bone fractures and detect the beginnings of tuberculosis of the lungs and other diseases. Strong X-rays can also be used in the treatment of cancer.

A modern X-ray 'tube' consists of a coil of wire, or *filament*, which emits a stream of electrons when an electric current is used to heat it. These electrons, being *negatively* charged, are attracted at high speed towards a metal *anode*, which is



Right: An X-ray photograph of valve electrodes, taken to check that they are properly spaced.

Left: An X-ray photograph showing leg fractures of the tibia and fibia. X-rays are an immense help to doctors, showing just where damage is and whether bones once set are healing properly.

In the art world X-rays have led to the rediscovery of a number of lost masterpieces. By X-raying a painting experts can tell whether another painting lies beneath it. X-raying can also reveal any corrections the artist may have made to his painting.

positively charged by a high-voltage electric current. The 'bombarding' electrons then cause the atoms of the anode to emit X-rays.

Y

Yak The yak is a member of the cattle family that lives in the high mountains of central Asia. It is a large, heavily built animal that may stand nearly 6 feet high at the shoulder. It weighs over 1,000 pounds. It has long, shaggy hair. In wild yak, this is all black, but domestic breeds may be all white or have white patches. Smooth dark horns grow from the yak's head.

The yak is an important domestic animal in the Himalayas. It provides milk, butter and meat to eat. Its hide is turned into leather and its hair is woven into cloth. It is a sturdy pack animal, carrying heavy loads up to 20 miles a day.

Yangtze This is the longest river in China and the third largest in the world. It rises in the Kunlun mountains of Tibet, 16,000 feet above sea-level, and follows a winding course for more than 3,000 miles to flow into the Yellow Sea. The Yangtze, together with its many tributaries, drains about 700,000 square miles. More than 200 million people live along or near the

The yak is found in Tibet. It is related to the bison of North America.

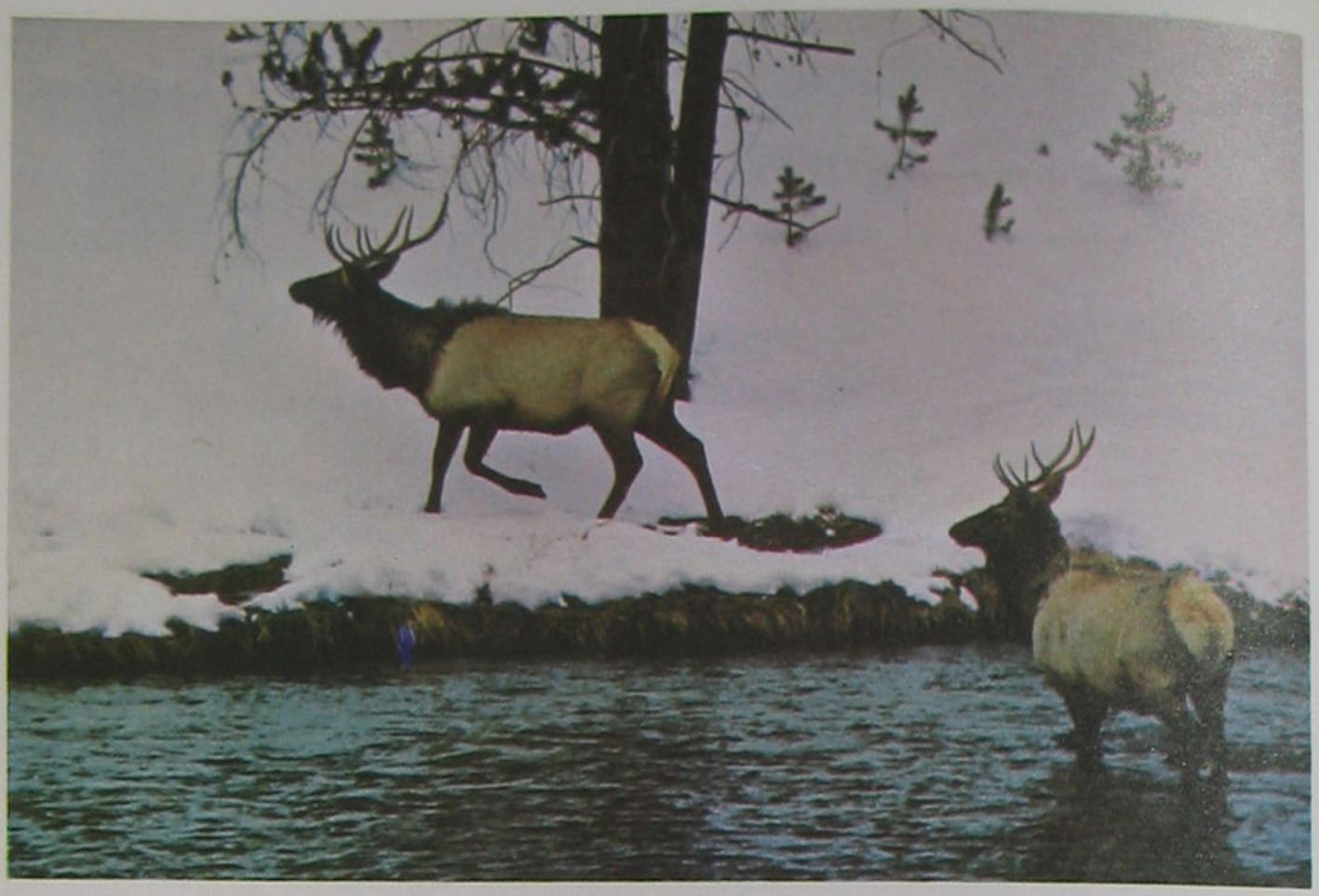
Yangtze and its tributaries. Some of them live on the river in boats.

The Chinese have different names for the Yangtze, according to which part of China it flows through. Only at its mouth is it called the Yangtze by the Chinese.

Yeast is a one-celled fungus that has many important uses. Yeast can live comfortably without oxygen. It breaks down sugars to alcohol and carbon dioxide, deriving energy for its own needs in the process. Manufacturers of all kinds of alcoholic drinks—wines, spirits, beer, cider—make constant use of yeast. Wine and cider yeasts occur naturally on grapes and cider apples. Beer yeast, however, which acts on the sugars of sprouting barley, is not known in the wild state.

Bread is made in the traditional manner by adding a small quantity of baker's yeast to dough. The yeast cells feed on the traces of sugars in the wheat flour, yielding alcohol and carbon dioxide. When the bread is baked, trapped carbon dioxide expands in the dough, producing the light, spongy texture. The alcohol evaporates. The yeast fungus is killed by the high temperature of the baking.

Yellow Fever is a dangerous virus disease of wet tropical regions such as western Africa, and the Caribbean and in Latin America. It is spread by certain kinds of mosquitoes. People with yellow fever show a rise in temperature accompanied by vomiting. In severe cases the eyes



Elk in the Yellowstone National Park in wintertime. This is the oldest and most famous of the American National Parks, and was established in 1872.

and skin turn yellow and bleeding occurs. Yellow fever killed many of the workers building the Panama Canal from 1881 to 1920. Travellers to yellow fever areas are now usually inoculated against the disease, which has become rare.

Yellowknife, the capital of Canada's sparsely-populated Northwest Territories, lies on Yellowknife Bay, at the northern end of the Great Slave Lake. Founded only in 1930, it has a population of about 4,000. The town serves as the centre for a goldmining area.

Yellowstone National Park in the United States lies mainly in north-west Wyoming. It is set in valleys on both sides of the Rocky Mountains and lies more than a mile and a half above sea level. Four-fifths forest, the park has an area of about 3,500 square miles and is rich in animal and plant life. Fishing is allowed, but hunting of animals is forbidden.

Magnificent in scenery, Yellowstone has more than 200 active geysers, the most famous being Old Faithful, which spouts about once every hour. Many of the park's 3,000 hot springs bubble at boiling point. Yellowstone was established in 1872.

Yemen Arab Republic is a country in the south-western corner of the peninsula of Arabia. It is bounded by Saudi Arabia on the north and east, Yemen People's Democratic Republic on the south, and the Red Sea on the west. Its area is 75,290 square miles.

The western coastal strip, known as the *Tihama,* is a hot, semi-desert area. But inland, where there are high plateaus and mountains, the climate is pleasant and the land fertile. This region is one of the few parts of Arabia that receive adequate rainfall. Eastern Yemen slopes towards a desert.

Yemen's 5,700,000 people are nearly all Arabs, and practise the Muslim re-

This map shows the location of the Yemen Arab Republic. Its eastern border is not strictly defined.

This map shows the location of the Yemen People's Republic.

ligion. Most of them are poor, and live by farming. Coffee and a narcotic plant called *qat* are the chief exports. Millet, maize, and fruits are grown too. Apart from handicrafts, there is hardly any industry. Most of Yemen's people live outside the towns. The largest towns are San'a, the capital, and Taiz. Camels are still a major means of transport.

Yemen was the land called Sheba in the Bible. Muslim invaders conquered it in the 600's A.D. The Ottoman Turks ruled from the 1500's. Yemen became independent in 1918, after Turkey's defeat in World War I.

In 1958 Yemen joined with Egypt and Syria in a loose federation called the United Arab States. This lasted until 1961. In the following year, a group of army officers overthrew the traditional ruler, the *imam*, and set up a republic. Civil war continued until 1968. The republicans received the backing of Egypt. The supporters of the imam received aid from Saudi Arabia.

Yemen, People's Democratic Republic of (South Yemen) stretches for about 700 miles along the southern coast of Arabia. It covers about 111,000 square miles, mostly of dry, sandy desert, but its frontiers are not clearly defined. Its estimated population in 1973 was 1,300,000. Many of its people live in the semi-desert areas and depend upon raising livestock for their living.

British troops took Aden, South Yemen's chief port, in 1839. From a town of 600 people they developed it into a military base and the major refuelling port for ships passing through the Suez Canal. From Aden, a British protectorate was established inland, over the south-western corner of Arabia. South Yemen guerrilla forces fought British troops to win independence in 1967. The country refused in 1969 to unite with North Yemen, and a period of bad relations followed between the two Arab countries.

Yenisei River, one of the world's longest rivers, flows about 2,400 miles through the U.S.S.R. It is formed by two headstreams that rise near Mongolia. The Yenisei flows west, then north through Siberia, to empty into the Arctic Ocean. Its three chief tributaries are the Upper, Stony, and Lower Tunguska, all on the right bank. Navigable to the town of Kyzyl, the Yenisei is ice-free only from July to October.

Yoga, an Indian word, originally meant union with Brahma, the divine world soul. A *yogi* (person who practises yoga) is one who isolates himself physically and mentally from his surroundings. Yogis achieve such discipline over themselves that they can, for example, move and maintain their arms and legs in positions that seem impossible by normal standards. They reduce to a minimum bodily activities such as breathing and thinking, to achieve a state of almost complete rest.

Yoga is becoming more and more popular in the Western world as a means of physical and mental discipline. But it is generally at a simpler level than in the East.

Mind control is gained by deep concentration. Very few people can achieve the standards of the yogi. At a simpler level, yoga has become increasingly popular in the Western world as a way of keeping physical and mental discipline.

Yorkshire, the largest county in England with an area of 6,100 square miles, lies on the north-eastern coast of the country. It was divided into the administrative counties of East Riding (county town, Beverley) West Riding (county town, Wakefield), North Riding (county town, Northallerton), and the City of York. A *riding* means a 'third part'. The county town of Yorkshire is York, and the total population is 5,152,000.

Although Yorkshire has a long coastline on the North Sea in the east, between the estuaries of the Tees and the Humber, part of its western boundary reaches to within 8 miles of the Irish Sea. In the north-west, the bleak Pennine Hills rise to a peak at Mickle Fell (2,591 feet). Beautiful *dales* (valleys) cut into the hills. These dales, such as Wensleydale, Nidderdale and Wharfedale, are formed by the Ouse and its tributaries. In the centre of the county lies the long plain of York, and farther to the east are more uplands consisting of the North Yorkshire Moors and the Yorkshire Wold.

Agriculture is the main occupation in the East Riding. Farmers rear cattle and sheep, and grow wheat, root crops and green vegetables. In the West Riding a huge industrial region has been built on the great coalfield. Leeds, Halifax, Huddersfield and Bradford are thriving centres of the textile industry, chiefly woollens. Sheffield, together with Mid-

The rich Yorkshire coalfield has played a major part in the economic and industrial development of the county. Coal was necessary for the growth of the iron and steel industry of the Don Valley, and Sheffield is now one of the largest producers of steel goods in Britain. When the woollen industry turned to steam power to drive its machinery, the much needed supplies of coal were on the doorstep.

dlesbrough and Rotherham, produces iron and steel goods. Hull is one of Britain's leading commercial and fishing ports.

Young, Thomas (1773-1829), was an English physician and physicist who made important contributions to the study of light and vision. He showed, for instance, how the muscles of the eye change the shape of the lens in order to focus on objects at varying distances—a process called *accommodation*. He was the first to describe the visual defect known as *astigmatism*, which is caused by an irregular curvature of the cornea of the eye.

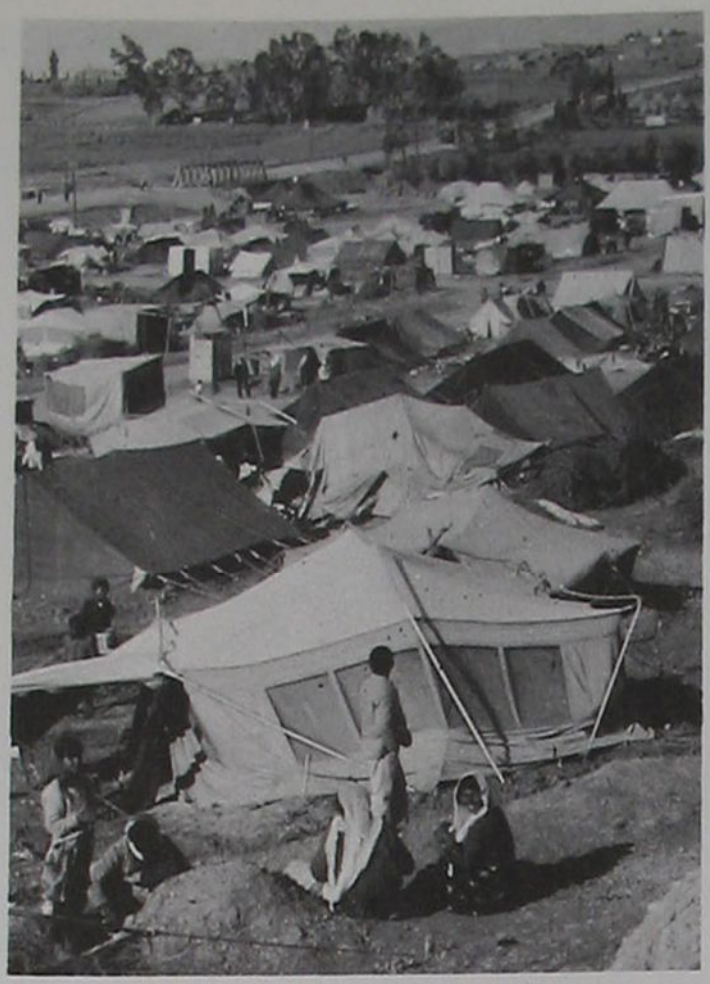
Young was interested in the basic nature of light. He experimented with light interference in order to prove that light behaved more like a wave than a stream of tiny particles. His studies led to the modern wave theory of light. Young measured the wavelengths of different colours, and tried to explain how our eyes see things in colour.

YMCA and YWCA are abbreviations for *Young Men's Christian Association* and *Young Women's Christian Association*. These international organizations for young people aim to help their members improve their lives. They provide a club in which to meet and a programme of wholesome activities. The YMCA and YWCA run hostels, summer camps, sports groups and classes in a wide range of subjects.

Although the organizations are Christian, their activities are open to people of all races and religions. Both men and women take part in YMCA activities. YWCA activities are mainly open to women and girls. They are established in over 70 countries throughout the world. They have millions of members.

The two organizations grew up separately and are still run independently. The YMCA was founded in England in 1844 by George Williams. His first idea was to set up a Christian study group. The organization soon extended its activities.

The village of Burnsall in Yorkshire. This huge county in north-east England has large industrial areas set in beautiful farming country.



The YMCA movement is constantly called upon to help refugees in all parts of the world. It set up this camp for Arab refugees in Jordan.

It became a world-wide organization in 1855.

The YWCA originated in two organizations. One was a prayer group founded by Emma Robarts in London in 1855. The other was a home for nurses in London, founded by Mary Jane Kinnaird.

Youth Hostels were first established in 1910 by a German schoolteacher who allowed young travellers to sleep on straw on his schoolroom floor. Basically, the hostels are simply furnished lodging houses where members of the Youth Hostels Association (YHA) can sleep overnight very cheaply. Originally the YHA existed to enable young people to see more of their own country. Now it provides mainly for those who want to travel in other countries. Hostels generally provide beds, mattresses, blankets and washing facilities and some offer cheap meals. Members help by sharing domestic work.

Yugoslavia is a country in the Balkan peninsula. It has a long coastline on the Adriatic Sea. The coastal plain and offshore islands are popular with tourists from all over Europe. Mountains rise behind the narrow coastal plain. To the east of the largely dry and infertile mountains lies the rich, well-watered inland plain. The coastal region has a typically Mediterranean climate. The inland plain has hot summers and cold winters.

The people are South Slavs who are divided into five groups: Croats, Serbs, Montenegrins, Macedonians and Slovenes. Yugoslavia has three official languages. Most people are Christians, but there are some Muslims.

About half the people are farmers. They grow such crops as fruit, grapes, maize, olives, sugar-beet, tobacco and wheat. They also rear animals. Yugoslavia also produces coal, iron, petroleum and timber. Ship-building and electrical engineering are among the country's most important industries.

For hundreds of years, the area that is now Yugoslavia was ruled either by the Turks or the Austrians. In 1918, the Slav countries joined together to form an independent kingdom. It was named Yugoslavia in 1929. The country was invaded during World War II. In 1945, the country became a communist republic. In the 1950's and 1960's, Yugoslavia modernized its agriculture and began new industries.

Yugoslavia has many magnificent beaches on the Adriatic coast. Much of the coastline has been developed into holiday resorts. Tourists from both Eastern and Western Europe go there for their holidays.

Yugoslavia is a country of many contrasts. On the narrow coastal strip along the Adriatic, there are many fine beaches, and tourism is becoming increasingly important. But rising abruptly from the coast are rugged mountains, where the land is very difficult to cultivate. Beyond the mountains lie the rich fields and forests of the Danube valley, where much of the country's farming is done.

Above: Location map of Yugoslavia.

A view of Split, on the Dalmatian coast of Yugoslavia. Split and other Adriatic towns such as Dubrovnik have a long and colourful history. The coastline from Split to Trogir is known as the Riviera of the Seven Castles, and is becoming increasingly popular as a holiday resort.

Facts and Figures
Area: 98,766 square miles.
Population: 20,600,000.
Capital: Belgrade.

Yukon River is one of North America's longest rivers. It extends nearly 2,000 miles from its source in British Columbia to its mouth on the Bering Sea. It has a number of tributaries. The Yukon flows past the settlements of Whitehorse and Dawson in the Yukon territory and cuts across Alaska. During the summer months almost the whole length of the river is navigable. During gold rush days it was the chief means of transport in the region.

Yukon territory occupies the north-western corner of Canada. It borders on the Northwest Territories, British Columbia, Alaska, and the Arctic Ocean. The Yukon is a cold and largely undeveloped region. Only 16,000 people live in its 207,076 square miles. Some of these are American Indians. Most people in the Yukon make their living from mining. The metals they dig include zinc, silver, lead and gold. Fur trapping is also important.

The Yukon is a rough, hard land. High mountains cover much of it. The highest peak in Canada is the Yukon's Mt. Logan (19,850 feet), located in the Saint Elias Mountains. Other ranges are part of the Rockies. The Yukon River and its branches are the chief rivers. The Alaska Highway cuts across the territory. Nearly a third of the territory's people live in Whitehorse, the capital.

The Hudson's Bay Company of fur traders sent the first white men to visit the Yukon. They established a trading post there in 1848. The Klondike gold rush of 1898 brought in thousands of prospectors.

This map shows the location of the Yukon territory.

Z

Zaïre is a republic in central Africa. Until 1971, it was known as Congo (Kinshasa). Kinshasa is its capital. Zaïre is the continent's third largest country. It has an area of 905,565 square miles. In the west it has a small coastline on the Atlantic Ocean. The equator cuts across central Zaïre near the Congo River. This region is chiefly hot, steamy tropical forest. Elsewhere there are mountains and grasslands. Zaïre is rich in wild life.

This map shows the location of the Zaïre Republic.

Zaïre's population of 17,400,000 includes Bantus, brown-skinned Hamitic people and pygmies. Many people are farmers. Others work in the mines. The country exports copper, industrial diamonds and coffee. French is the official language. But Swahili is in common use.

King Leopold II of Belgium sent Henry Stanley to explore the Congo in the late 1800's. The region became a Belgian colony (called the Belgian Congo) in 1908. It won its independence in 1960.

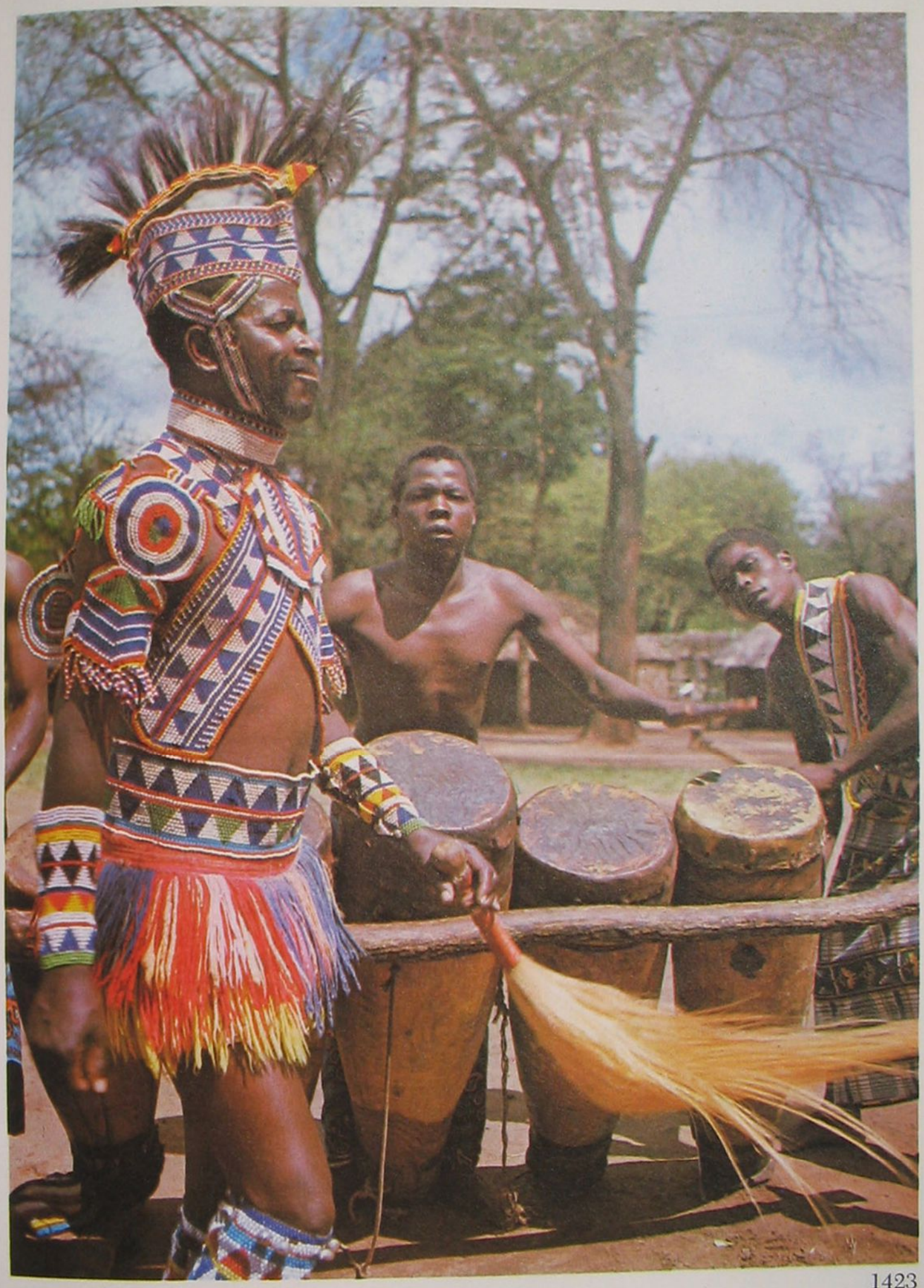
Zambezi is a major African river. It flows for more than 1,600 miles in the shape of a giant S-curve. It rises in north-west Zambia and enters the Indian Ocean in Mozambique by a swampy delta. It crosses Angola and forms the border between Zambia and Rhodesia.

Upstream, the Zambezi flows through flat land. But along much of its course it flows through deep gorges, forming many rapids and waterfalls. The most magnificent of these are the Victoria Falls. At Kariba Gorge, a huge dam has been constructed, creating one of the world's largest artificial lakes. Only the lower portion of the Zambezi and one of its channels is navigable. Elsewhere, a few road and rail bridges cross it. The British explorer, David Livingstone, was the first European to see the Zambezi, in the late 1850's.

This map shows the location of Zambia.

Zambia is a republic in south-central Africa. It has an area of 288,130 square miles. It has no coastline on the sea. The country consists mainly of a flat, tree-covered plateau. The climate is mild. There are many rivers and lakes, including the great Zambezi River. Most of Zambia's 4,300,000 people speak Bantu languages. They grow maize and other food crops. But mining—especially of copper—brings in most of the country's wealth. Zambia is the third largest producer of copper in the world. Zambia was formerly the British protectorate of Northern Rhodesia. It became independent in 1964. Lusaka is the capital.

Opposite: Vimbuza dancers ceremonially dressed with elaborate beadwork. The people of Zambia are largely Bantu.



Zebras drinking at a pond. Their bright stripes are, in fact, a form of camouflage.

Zanzibar, a small island 23 miles off the coast of eastern Africa, is part of the republic of Tanzania. It is one of the world's main suppliers of cloves, a spice which came to be much prized by the Europeans in the late Middle Ages. Portuguese sailors seized Zanzibar from its Arab-African ruler in the early 1500's, but the Arabs took it from them in 1698. By 1890, Zanzibar came under the control of Germany, which exchanged it with Britain for Heligoland, an island off the German coast. Zanzibar became an independent state in 1963, and in 1964 united with Tanganyika to form Tanzania.

Zebra The zebra is a black-and-white or brown-and-white striped wild horse that lives in Africa. The stripes extend from head to tail and down the legs. They seem conspicuous, but in fact help to camouflage the animal, breaking up its outline against a varied background. Zebras stand about four to five feet high at the shoulder. There are three living kinds. The long-eared mountain zebra lives in the mountainous parts of southern Africa. It is an agile creature but very rare. The common zebra lives on the plains from the Sahara to South Africa. Grevy's zebra lives in north-eastern Africa. It is the biggest and most closely striped kind.

Zinc is a metal used as a thin coating over steel to protect it from corrosion. Coating steel with zinc is called *galvanizing.* (See Galvanizing.)

Zinc also forms important alloys, such as brass, in which it is combined with copper. Alloys of zinc and aluminium are used for diecasting—casting in metal moulds or dies. Many parts of automobiles

Tapping molten zinc. The zinc is tapped periodically into ladles.

and domestic appliances are made of die-cast zinc alloys.

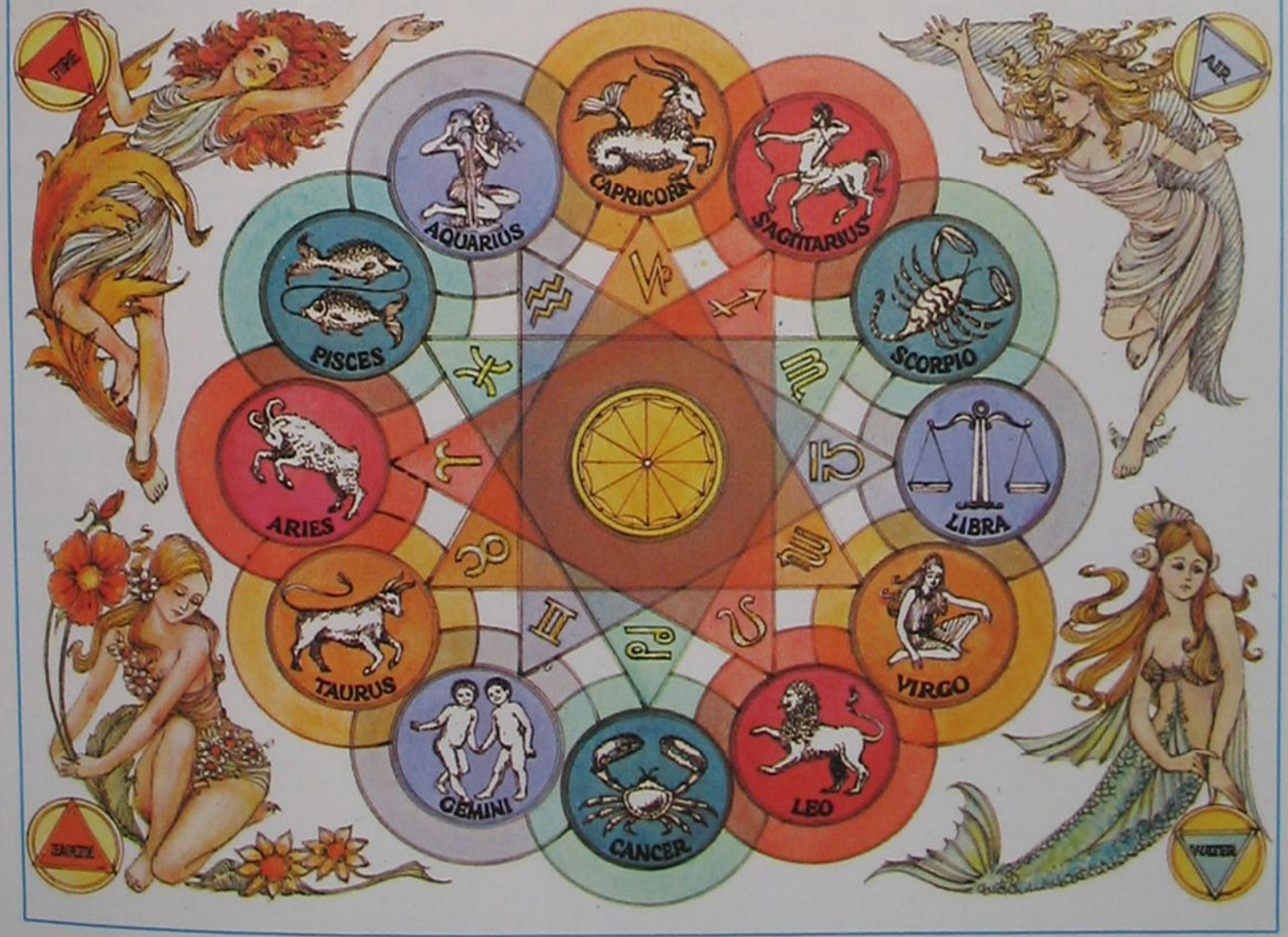
In the form of sheet, zinc is used for roofing and in dry electric batteries.

Most zinc comes from the sulphide ore zinc blende, or sphalerite.

The Chinese of the 7th century B.C. had a zodiac of 12 signs which was very like that of the Babylonians. They used the names of animals for the signs—dog, cock, ape, ram, horse, snake, dragon, hare, tiger, bull, rat, and pig. But to them their lunar zodiac of 28 'mansions' was more important.

Zodiac is a plane through which lies the path of the Sun, Moon and main planets. Babylonian magicians divided the zodiac into 12 segments each of 30 degrees and Greek astrologers took over their ideas. They named each segment after a group of stars in it to which they had given a familiar name like Taurus (Bull) or Sagittarius (Archer), according to the pattern the stars seemed to have. To each of the 12 names and signs of the zodiac, they gave precise dates of influence. For example, Taurus covers the dates 21st April to 22nd May (in our present calendar) and

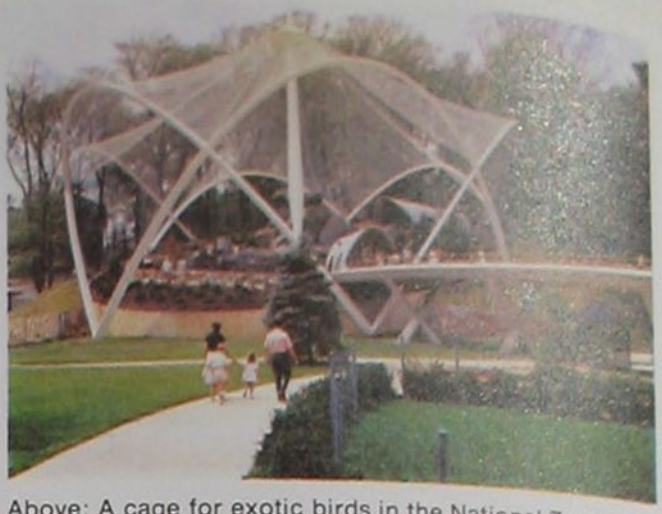
The Signs of the Zodiac



people born within those dates are said to be influenced by that constellation. Possibly half the world's people still 'follow their stars'. Some people, especially in India, pay professional astrologers to draw up personal horoscopes predicting their 'fortune'.

Zoo This is a place where a collection of wild animals is kept in captivity. Zoos are usually in the form of a park or enclosure, where various animals are kept in cages, compounds, pits, tanks, and various other enclosures.

Public zoos have two basic purposes. First, they enable people to see animals they would never otherwise see, and to learn about them and their habits. Second, they enable *zoologists* (scientists who study animals) to watch animals at close quarters and learn more about them. A third function, and one which is increasing in importance, is the preservation of species which for some reason are dying out. The Hawaiian goose, for example, which was nearly extinct in the wilds, was bred in zoos until there were enough to release them again in their natural home.



Above: A cage for exotic birds in the National Zoological Park in Washington, D.C. The public can walk right inside the cage, which is constructed of steel mesh on a concrete frame.

Most big cities have one or more zoos of some kind. Some are quite small collections of animals of a particular type, or from a particular region or environment. But most are general zoos, with a

The llama park at Whipsnade Zoo in England. Here the animals are kept in large enclosures where they can live a more natural life than in cages.

A group of Zulu dancers. Their shields are made of hide and as they move shells round their ankles make a curious rustling sound. In the background are characteristic Zulu beehive huts.

varied collection of animals from all over the world. Regent's Park Zoo, in London, has the greatest number of different species (kinds) of animals of any zoo in the world. The world's biggest zoo is Bronx Zoo, in New York.

The amount of space is not necessarily the most important factor in designing a zoo. Some animals, such as deer, need a large area, but others, such as chimpanzees, are happy in a small space so long as they have plenty of things to play with. Many modern zoos do not use old-fashioned cages with iron bars. Instead, they have such barriers as trenches, moats, low walls and glass to contain the animals. As a result, the surroundings seem much more natural to both the animals and the visitors.

Some of the Egyptian pharaohs are known to have kept menageries, while Roman generals often brought back specimens of strange wild animals with which to astonish their admirers and sometimes to use in combats in the arena. In England, King Henry I started a private collection at Woodstock near Oxford. This was later removed to the Tower of London where it remained until 1834.

Talking points

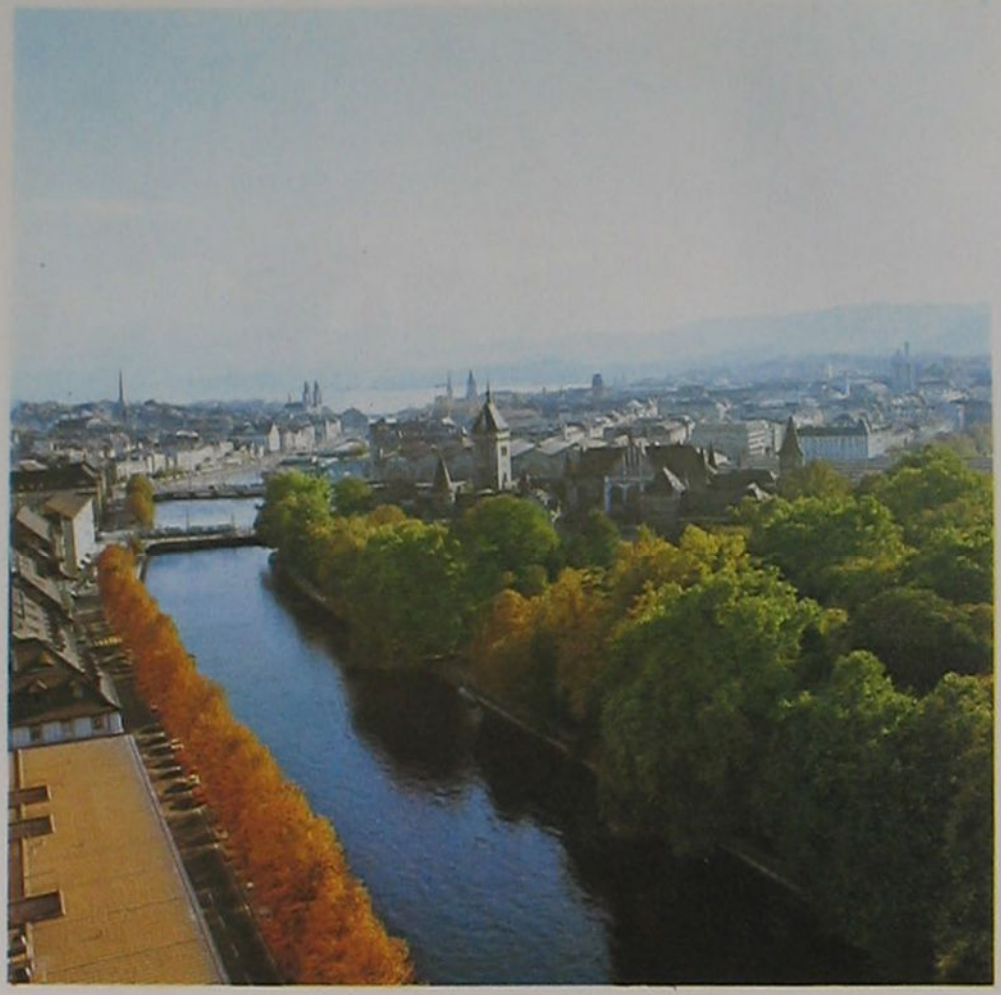
* Some people argue that it is cruel to keep wild animals in zoos behind bars, while others hold that zoos are a great help to the cause of conservation. Discuss these two points of view.
* In recent years, there has been an increase in the number of game reserves and wild-life parks. Do you think that these will eventually replace zoos?
* Draw up a plan for your ideal zoo. Say what animals you would have in it; and how you would keep them from escaping while retaining realistic surroundings.

Articles to read:
Conservation; Ecology.

Zoology is the scientific study of animals of all kinds, including their appearance and structure, the way their bodies work, and their habits and ways of life. It is part of biology, the study of living things.

Zulus are a proud and handsome people of south-east Africa. They belong to the Negro race and speak one of the Bantu languages. There are over 3,750,000 Zulus in the world. The largest number live in Zululand, a 10,373-square-mile area on the coast of Natal province in South Africa.

Many Zulus still follow a traditional way of life. The typical Zulu *kraal* or



The river Limmat and the old town of Zurich.

compound consists of related families living under a chief or headman. Within the group, strict laws must be followed by everyone.

Zulu huts are constructed of sticks and grass, in the shape of a beehive on poles. Usually the huts are arranged in a circle, with a fence surrounding the kraal and marking off pens for the cattle. Looking after livestock and hunting are the traditional jobs for men, while women are left to cultivate crops such as maize.

The Zulus originated in Central Africa, from where they migrated to Natal in the 15th century. They remained weak and disunited until a powerful chief named Shaka arose in the early 1800's. Under Shaka, the Zulus fought other tribes in the area, driving them out. They were feared wherever they went. When the Boers moved into Natal during their famous trek, the Zulus put up a fierce resistance before yielding to the invaders.

The Zulus refused to submit to the British, and in 1879 Britain began the Zulu War by invading Zululand. At first, the Zulus, under their chief Cetewayo, repulsed the British, but within a year they were conquered. Britain annexed Zululand in 1887, and it became part of Natal colony in 1897. Peace was broken on two occasions by Zulu revolts in 1906 and 1907.

Zurich is the largest city in Switzerland. It lies on the banks of the River Limmat, at the north end of Lake Zurich. German is the language spoken by the city's 432,400 inhabitants. Zurich's important industries produce silk, cars, machinery and books. The city is famous for its many insurance companies and banks where non-Swiss depositors can keep money in secret, numbered accounts.

The Helvetii and Romans were early inhabitants of Zurich. It became a free imperial city of the Holy Roman Empire in 1218, and joined the Swiss confederation in 1351. It was an important centre of the Protestant Reformation.